JUL 14 1923

ENGINEERING & MINING JOURNAL-PRESS

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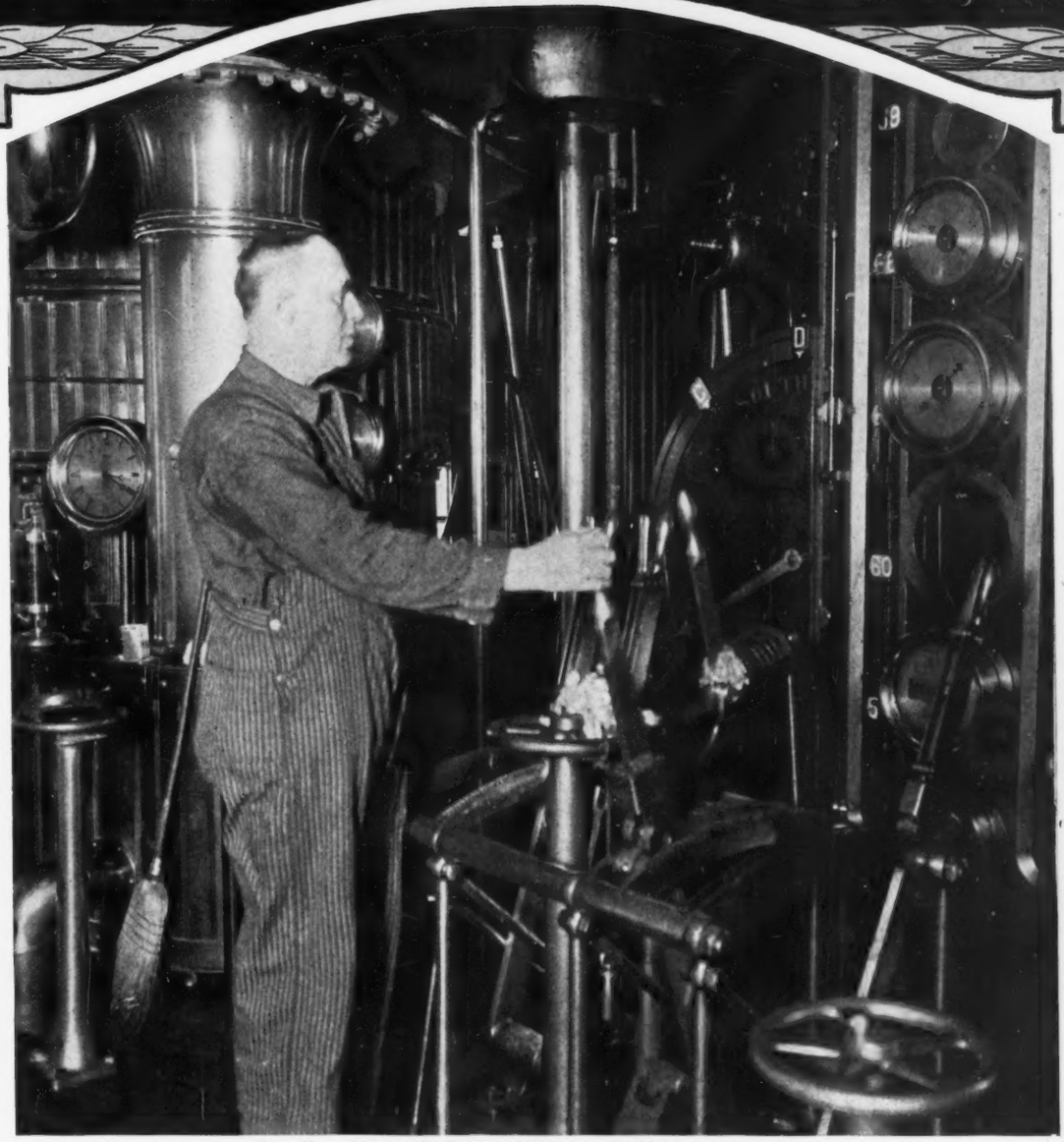

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July 14, 1923

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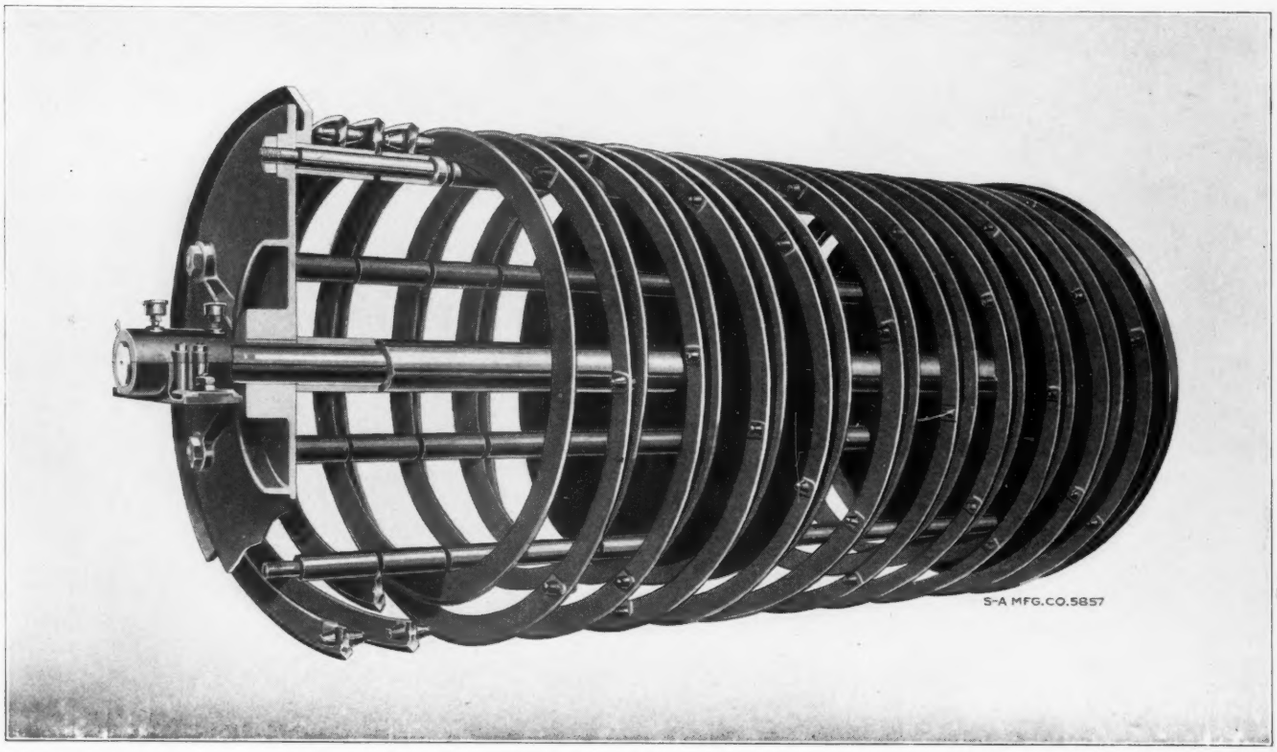

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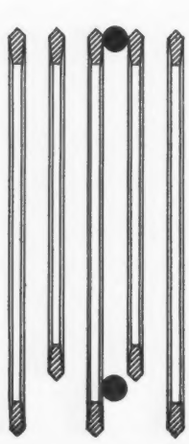

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ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, Editor

Volume 116 | New York, July 14, 1923 | *Number* 2

A Question of Elementary Economics

THE BUREAU OF STANDARDS at Washington has done a great deal of research on problems involved in the electro-deposition of metals. Several well-paid scientists—if there be such a thing in the government employ—have spent a lot of time and much money in experiment and in the compilation and interpretation of data relating to the subject. Some of the laws which govern action in electro-plating are still obscure, but any manufacturer who desires assistance can go to the Bureau and find in a single office virtually everything that anyone has ever learned about the subject. Moreover, he can get for nothing the advice of specialists who have been studying various phases of the process for years. There are industrial applications of electro-deposition of which the average man knows nothing; but all-told the number of firms that can take advantage of the work done by the Bureau technicians is small indeed, and most of them are large and rich corporations. Why then, asks the man in the street, should the taxpayer's money be spent on research along these lines? It may be all right, he argues, for the Department of Agriculture to study the problems of the farmer, because any valuable conclusions reached are of direct value to several millions of individual enterprises; but the electro-plating industry is another story. How, if at all, is the expenditure of public funds for helping, say, 500 firms to be justified? Simply on the old theory that the elimination of economic waste is for the public good.

Suppose each of these 500 firms were to undertake research as comprehensive as that done by the Bureau of Standards? Large sums of money would be spent on unnecessary effort and those sums necessarily would be added to the cost of the products made. The bill would ultimately be paid by the man who pays all the bills, the ultimate consumer, *alias* Mr. Taxpayer. Perhaps he thinks that he is not concerned in the cost of electro-deposition. He is mistaken. In these modern days every citizen every day buys something in which the cost of this particular operation is an element in the total cost.

On the other hand suppose the research were not conducted at all. The consequence would be inferior products or more costly products, and, in the end, economic waste which likewise must be settled upon the consumer. Although sometimes saving in the cost of production may accrue temporarily to the manufacturer in increased profits, the ultimate beneficiary must be the consumer.

Of course the whole argument is based upon the assumption that something of tangible practical value is accomplished by the government scientists, but that proposition is seldom questioned. It is also pertinent for the taxpayer to inquire whether the work of the investigators is performed with reasonable efficiency. Here again it is generally conceded that the technical bureaus function with reasonable economy and effectiveness, something that unfortunately cannot be said of all the cogs in the machinery of Federal Government.

We have used this particular work of the Bureau of Standards as a text because it happens that we heard asked the very question that we have discussed. The same reasoning, however, is equally applicable to a large part of the work of the Bureau of Mines. Whenever the engineers employed by the Bureau find ways of increasing the efficiency of mining or milling or smelting operations, of avoiding unnecessary loss of material, or expenditure of money, they are not increasing the profits of mining companies as much as they are cutting the cost of living for everybody in the country.

The Mining Industries and Fair Freight Rates

EFFICIENT AND ECONOMICAL railroad transportation is vital to the mining industries. This does not necessarily mean cheap rates, if, by giving low rates, the railroads cannot earn any profit. Conditions should be made such that rates will not be burdensome to shippers; that cars will be available; that shipment will be made in the minimum of time and with a maximum of safety; and that the railroads can make a profit on the transaction while paying a fair rate of wages.

In a bulletin recently issued by the American Mining Congress, over the signature of McK. W. Kriegh, it is pointed out that the railways are now in a prosperous condition, which is likely to continue, and that there is a prospect of a further reduction of rates, possibly greater than the 10 per cent cut made last year. "Railroad rates on products of mines and smelters," says Mr. Kriegh, "have received less general consideration, especially in cases before the Interstate Commerce Commission, than those applicable to any other class of traffic. . . . Although certain carriers have voluntarily reduced their rates on mine products to a level that permits normal traffic to move, no general reduction has been made to eliminate the inequalities and prohibitive rates which were introduced into the rate structure when the horizontal increases were made."

Transportation legislation will in all likelihood be a feature of the proceedings of the next Congress, which will meet in December, and it devolves upon the mining industries to express their thoughts upon the subject. The Transportation Division of the American Mining Congress advises that it invites expressions of opinion and suggestions regarding the policies which should be followed.

The mining industries have a right not only to be heard but to be considered before any other industrial group, for the mines normally furnish something like 56 per cent of the total railroad tonnage, though at

present, owing to the high rates, the figure is said to be somewhat less than this.

The *Journal-Press* has recently begun the publication of characteristic freight rates, which are to appear about once a month, as changes are made. This, we hope, will aid in an intelligent understanding of the problem, and we shall be glad to hear of further suggestions of ways in which we can help shippers. But a voice at Washington is needed, and the American Mining Congress may here have an opportunity for accomplishment.

The Questioning Spirit

AT A RECENT GET-TOGETHER of mining men in Grass Valley, Calif., Robert H. Bedford, superintendent of the North Star mine, stated that he welcomed visitors at the property in his charge, as they not infrequently asked embarrassing questions which stimulated inquiries into the technique and logic of the methods under question. Thus the chance question of the visitor may start the men in charge of a property to a detailed review of habitual procedure. Mr. Bedford candidly stated that he did not know why certain practices were followed in his mine. He knew that they were and that they had been in vogue for a long time. He was not prepared to say that they were either the best, or that some other procedure might not be better. This liberal spirit and the desire to get a different perspective by inviting the visitor to look things over is commendable and will ultimately lead an engineer to more thorough thinking than were he resentful of criticism, or so impatient as to discourage questioning.

A systematic analysis of minor and major procedure should be made by the superintendent of every mine. Why we do it thus and so, should be asked and answered in an impartial spirit. Experience is conducive to habit. Safety, economy, and minimum manual effort should characterize mining methods. Tools, labor, and procedure should be co-ordinated in accordance with the foregoing principle. Routine has its advantages. Within reasonable limits standardization is commendable. However, both routine and standardization should be subjected to close scrutiny and should be consistent with the mine conditions. Systematic operation means orderly procedure in accordance with a well-thought-out plan with which the superintendent, foreman, and shift bosses are familiar. Workmen should be instructed in the details of their routine work. Preliminary to this must arise the questioning spirit and candid introspection. Without it there can be little real progress. With it a moribund property can sometimes be made to yield dividends.

Textbooks and Their Prefaces

AN AUTHOR of a new treatise has a great opportunity for generalizing to advantage in the preface of his book, where he is permitted to discourse on sundry allied themes and thus gives us an insight into the aims and aspirations and mental caliber of the man, as a preparatory to the absorption of technical or scientific details. Thus in the preface to his recent book on "Motor Fuels" Professor Eugene H. Leslie reminds us that:

"The tendency of the human mind is to travel in ruts, and to follow the line of least resistance. In plant work this frequently results in using no end of ingenuity to perfect, in a mechanical way, an apparatus that may be inherently incorrect, or that at least can never be as efficient as that of another type. There is one remedy for this: A project or situation should always be subjected to critical analysis on the basis of scientific facts and laws. The result of this investigation will show the feasibility of the project or the true facts of the situation, and will indicate whether or not a change is advisable. With principles and facts clearly in mind it is a relatively easy matter to give these expression in the form of an apparatus or plant."

Such comments are needed. The study of fundamental principles is becoming a lost art. The line of least resistance is usually along the path that is strewn with the composite ideas of others. Research too often takes the form of hit-or-miss experimentation with sundry types of patented apparatus, seldom preceded with an adequate amount of thought or mental argument. Sir Thomas Holland, speaking in London recently, recalled Huxley's phrase "precocious mental debauchery," and reminded his hearers that students are too often crammed with facts rather than trained in methods. Thus may we be able to account for many failures in engineering work.

In another recently issued textbook, on "Thermodynamics," one may obtain an excellent idea of the intellectual outlook of the authors, Professors G. M. Lewis and M. Randall, in the preface, the following extract from which we commend to all lovers of good literature and advocates of sound reasoning:

"There are ancient cathedrals which, apart from their consecrated purpose, inspire solemnity and awe. Even the curious visitor speaks of serious things, with hushed voice; and as each whisper reverberates through the vaulted nave, the returning echo seems to bear a message of mystery. The labor of generations of architects and artisans has been forgotten, the scaffolding erected for their toil has long since been removed, their mistakes have been erased, or have been hidden by the dust of centuries. Seeing only the perfection of the completed whole, we are impressed as by some superhuman agency. But sometimes we enter such an edifice still partly under construction; then the sound of hammers, the reek of tobacco, the trivial jests bandied from workman to workman enable us to realize that these great structures are but the result of giving to ordinary human effort a direction and a purpose.

"Science has its cathedrals, built by the efforts of a few architects and of many workers. In these loftier monuments of scientific thought a tradition has arisen whereby the friendly usages of colloquial speech give way to a certain severity and formality. While this may sometimes promote precise thinking, it more often results in the intimidation of the neophyte . . ."

And then follows an informal but informative dissertation on the book and its purpose, in which the authors explain their attempt "while conducting the reader through the classic edifice of thermodynamics, into the workshops where construction is now in progress, to temper the customary severity of the science in so far as is compatible with clarity of thought."

In good scientific and technical literature there can be no exhibition of personal style—no divergence from the primary essentials of simplicity and brevity and clarity. In the preface of a textbook, however, the author is permitted more latitude; and a little color is not amiss to throw into bolder relief the seriousness of what follows—to remind us that scientists are human beings with a keen appreciation of the humanities.

Learn to Arbitrate

SO ACCUSTOMED have we all become to the proverbial delay of the law that the inconvenience and injustice often resulting from it are too frequently taken for granted, as being among the inevitable things of life. The congestion of court calendars in many places is serious, affecting all industries. Such a situation, befitting the Dark Ages, is out of place in the "enlightened" twentieth century. A moment of time today suffices to send one's voice around the world, but three years may be required to reach a trivial suit on the calendar. Under such conditions the rascal thrives and honest men are at a disadvantage.

Where questions of law are involved in industrial disputes, resort to the courts may be necessary, but if facts alone are in question, arbitration will be cheaper, quicker, and possibly more just. By far the larger part of disputes in our courts involve simply questions of fact.

The way has been paved in New York State, and the necessary machinery has been created, for arbitration of all disputes other than criminal and divorce cases. These latter are omitted because a third interest—the state itself—is concerned with them. Education of the public to employ arbitration, wherever possible, is necessary. New York's courts are jammed. At the first of the year there were 27,000 untried cases on the Supreme Court calendars in New York County alone, with twenty-eight judges who are able to hear only 8,000 cases a year, though 13,000 cases are being added annually to the list. The need of remedy is urgent. Hence the enactment of New York's Arbitration Law.

Under this law, two or more persons can agree in writing to submit any actionable controversy to arbitration, which agreement is binding and irrevocable. Thus litigation may be guarded against by provision for arbitration in the contract. The arbitrator may be anyone selected by the parties and, once selected, has power to subpoena witnesses and to compel production of material books and papers. The hearing will be governed by ordinary common sense and not by "rules of evidence." The verdict will rest with the arbitrator and not with a jury which has no knowledge of the matters involved. The arbitrator's award, upon application of either party, will be confirmed by the court, and then becomes enforcible as the judgment of that court. The award is final and can be vacated only for fraud or misconduct.

The Arbitration Society of America, which has the furtherance of the matter at heart, has established a so-called Tribunal of Justice in New York City, where the individual groups of disputants and arbitrator may meet, and where witnesses may be heard. The Tribunal is intended to supplement the courts and not to supplant them. Later the society proposes to organize and equip similar tribunals in other large cities. A uniform arbitration law in all states is its aim, and it seeks to encourage the insertion of an arbitration clause in all trade and industrial contracts.

In arbitration alone seems to lie the only discernible remedy for clearing the present congestion of the courts, which is largely responsible for the law's delay. This delay not only works in favor of the dishonest but also to the advantage of the wealthier of two opposing litigants. There will be less talk of one law for the rich and another for the poor if the machinery of the law can be speeded up.

Ex-Secretary Fall a Sinclair Employee

THE DISPATCH from Moscow in the *New York Times* of July 3 that "H. F. Sinclair, head of the oil company bearing his name, arrived in Moscow today, accompanied by ex-Secretary Fall, in an advisory capacity" has astonished many of our readers. Secretary Fall's last important official act was to lease the famous Teapot Dome oil field, in Wyoming, on behalf of the Navy, to the Sinclair interests, an act for which he was much criticized by those who argue in favor of conservation and future preparedness, but which was justified in argument by Secretary Fall's friends. Almost immediately afterward Secretary Fall resigned, and now turns up in Moscow in an advisory capacity to Mr. Sinclair!

To say the least, Secretary Fall has been indiscreet, and, at the least, obtuse to those appearances of fitness and dignity which are recognized as necessary by the finer type of Americans. Secretary Fall may be politically as chaste as ice and as pure as snow; but he courts unfavorable conclusions with a dull indifference which will not heighten him in the general regard. It is a great pity that President Harding must appoint men of inferior type to even Cabinet positions.

A Ten-Dollar Speculation

THE MOST DIFFICULT PROBLEM of the man who wants to develop a "showing" of ore on his mining claims is to finance operations beyond the point of trenching, or sinking and tunneling on a small scale. A wrinkle in promotion that may not be entirely new, but that may, at the same time, suggest ways and means to other owners of prospects, is being successfully used by Messrs. Stratton & Stratton, of Wallace, Idaho. They have an option on some ground known as the McPhillips property, in the Nine Mile section of the Coeur d'Alene, in Idaho. Surface exposures and an adit 150 ft. into the mountain had disclosed a showing that made an attractive venture. The extension of the adit 500 ft. further was needed.

The owners did not have the money and could not raise it. Recently the Messrs. Stratton took a bond and option on the property for $15,000 on the following terms: They will proceed to extend the tunnel, but no payment will be made until profitable shipping ore has been found. Sixty days from that date (providing it ever arrives) $2,500 is due; seven months later $5,000 must be paid, and fourteen months after the discovery of commercial ore the remainder of the $15,000 is payable. By this arrangement the money raised by the bonders is applied directly to development until such time as the marketable ore has been proved.

Fine, but no money has been raised! Oh, yes it has. Stratton and Stratton are selling $10 option certificates, of which they have just 1,500. They sell only one certificate to an individual. If the development work discloses sufficient ore to make it worth while, a company will be incorporated, with the certificate owners as shareholders, and it will proceed to make a mine—if there is one there. If the preliminary development fails to come up to expectations, the bond and option will be surrendered, and the individual ten-spots will be charged on the educational side of several hundred profit-and-loss accounts. Will the promotion scheme work? It is working, for that adit is growing longer day by day.

DISCUSSION

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Selective Flotation at Simon, Nev.

THE EDITOR:

Sir—In your issue of May 26 E. Hedburg writes on "Magnetic Separation of Complex Lead-Zinc Ores" and recommends magnetic separation as the most economical process of treatment for complex ores generally. Reference is made to repeated failures of selective flotation when applied to complex ores, and this process is condemned as "impossible."

Mr. Hedburg's statements are interesting and instructive in reference to magnetic separation, but convey a false impression regarding selective flotation to anyone not familiar with the work that can be accomplished by this process. It is true there have been failures in applying it on a commercial scale, but history shows that "failure" is the price the industry usually has to pay in the development of new processes of ore treatment. Because a process has not come up to requirements in particular instances is not a sufficient reason for condemning it without trial. If such a method of reasoning was applied generally, the majority of metallurgical processes at present in successful use would never have been developed, and this applies particularly to magnetic separation.

Doubtless there were special reasons in each case for the failure referred to, but probable reasons may be cited due to inherent characteristics of the process itself. It has a restricted application; it is delicate of adjustment and requires considerable skill in manipulation. There are important factors influencing results that are little understood, and the reasoned deductions of the scientific investigator are at a discount. Information regarding work that is being done elsewhere does not help much—each individual case must be worked out on the spot. These may be considered drawbacks to the use of the process, and carry the germ of failure if the right remedy is not applied. In some instances, where failures have been recorded, other and better-known processes were first tried and found wanting. This was the case at the Afterthought Copper, referred to by Mr. Hedburg. At the plant of the Bluestone Mining & Smelting Co., in Nevada, a magnetic separation process was first tried and was superseded by flotation. There are no doubt specific instances where one process can be used to greater advantage than the other, but what I desire to emphasize is that satisfactory results can be and are being obtained by selective flotation where it is applied to the right ore under suitable conditions.

To illustrate the character of work that is being done by selective flotation I give in the accompanying table the results of a typical daily run (May 29, 1923) at the mill of the Simon Silver-Lead Mines Co., at Simon, Nev.

The calculated percentages and weights of concentrate based on the assay values agree closely with actual concentrate produced. For the month of May the average extractions were: Silver, 84.5 oz.; lead, 87.1 per cent, and zinc, 62 per cent.

The grade of zinc concentrate, although fairly satisfactory, is kept down by the presence of marmatite (a combination of iron and zinc) in the ore. No trouble is experienced in disposing of the zinc concentrate. This product is not the bugbear to the smelter that it was a few years ago, on account of improved equipment for dealing with it. A serious economic factor, however, is the high freight charges to and from the mine, which is situated in a mountainous region and 23 miles from Mina, the nearest railroad point. The cost for haulage of concentrate over this distance is $4.50 per ton. The railroad rates to eastern points are high and discriminatory, and a case is pending before the Interstate Commerce Commission to have these rates revised. At present zinc concentrate is being held at the mine awaiting a decision.

These high freight rates necessitate production of a high-grade zinc concentrate, even at the expense of greater tailing loss and decreased extraction.

The flow sheet of the Simon mill was published in the *Mining & Scientific Press* of Dec. 3, 1921 ("Design of Flotation Plants," by Arthur B. Parsons), a few weeks prior to the starting of operations. The capacity of the mill has been increased somewhat since then, but the flow sheet is practically the same, the only change of note being in the flow of pulp through the cells and the kind of reagents used.

The operating results will be of interest as a sequel to the publication of the flow sheet in Mr. Parsons' article dealing with some modern flotation plants. The efficiency indicated has only been attained by painstaking experimentation on the part of the officials of the company, and is a good example, shall I say, of the Napoleonic tradition that there is no such word as "impossible."

WILLIAM MACDONALD.

Nevada.

Results of Typical Daily Run of Simon Mill

Plain	Weight of Concentrate Produced		Assays			Metal Content			Per Cent Metal Distribution		
	Per Cent	Tons	Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Ag, Oz.	Pb, Tons	Zn, Tons	Ag	Pb	Zn
Heads	100	228	2.72	5.4	5.1	....	....	....	....	....	....
Lead concentrate	7.7	17.56	32.00	64.8	9.3	561.92	11.379	1.633	87.2	95.3	14.1
Zinc concentrate	6.0	13.68	2.60	1.9	47.0	35.57	0.260	6.430	5.5	2.1	55.4
Tailing	86.3	196.76	0.24	0.15	1.8	47.22	0.295	3.542	7.3	2.6	30.5
						644.71	11.934	11.605	100.0	100.0	100.0
Derived head assays						2.83	5.2	5.1			

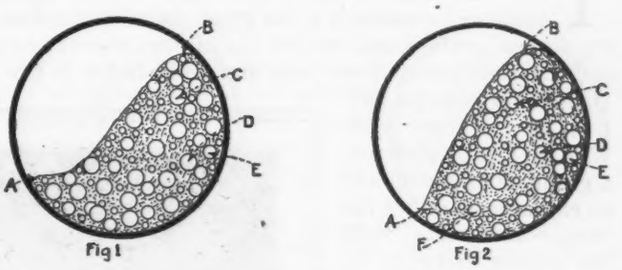
Is Much Grinding Accomplished on the Ball-mill Liner?

THE EDITOR:

Sir—In the main there are two conditions which occur within the mill as far as the effect of grinding upon the lining is concerned. The first is that case where there is no appreciable slippage between the mass (balls and material) and the lining, and the other where slippage is allowed to occur. In the first case, slippage is prevented by liners made with large projections, such as lifter bars raised above the lining proper two or three inches, or overlapping plates. When the mill rotates, the mass is lifted up to that point where the angle of repose is exceeded, and that portion over the angle of repose starts to slide. If the mill is rotating very rapidly, it may be carried sufficiently beyond so that a cascading action will occur. Considering these two cases for the present, we have the slow-speed mill illustrated in Fig. 1 and the high-speed mill in Fig. 2. In both cases, in addition to the top layer of balls and material sliding down the incline or dropping, as the case may be, other layers will also tend to slide or drop, depending upon the speed and the amount that they have been carried beyond the maximum angle of repose. This sliding action, particularly with the slow-speed mill, results in an attrition between the balls and materials, and in the case of the slow-speed mill, as near as can be judged by experiment, what is known as a "boot" occurs at the bottom. This is the carrying forward of the balls and material on the lining after it has reached the bottom due to the momentum gained in falling down the incline. The on-coming mass above this boot strikes the balls and material already on the lining. It should be noted here that there is really a layer of balls or perhaps two or three layers of balls at the point where the greatest sliding or cascading effect occurs, and thus the top layer is just as likely to strike balls, and in fact more likely to strike the balls next to the lining, than it is the lining itself. Consequently, the grinding is done mainly against the balls.

To reiterate, referring to Fig. 1, in the case of the slow-speed mill, the mass of balls and material at position *b*, the outside layers have the greatest velocity; those at position *c* somewhat less, and those at positions *d* and *e* we will assume negligible. The result means a relative movement between positions *b*, *c* and *d*, and a considerable grinding effect within the mass itself and a minor effect at position *a* against the lining of the mill.

Now turning to Fig. 2, where the mill is rotated at higher speed. Experiments and experience as far as we can determine show that the cascading action eliminates the "boot" and therefore the balls and material drop directly on the lining again at position *a*. This would seem to cause greater wear than would occur in the same position where the mill is operated at slow speed as indicated in Fig. 1, but now the mass is so livened that at position *b* and *c* there is practically no contact between the freely falling mass and material, but we do get contact between positions *d* and *e*, for *d* now would be slightly moving relative to *e*. Carrying the line of reasoning to position *f*, we would off-hand consider that at *f* the action would be similar to the action at *a*, *a* being in this case the very outside layer of balls, but such is not apparently the case, for though the balls strike at position *a* they tend to rebound, and their action is stopped by the on-coming mass above them. This would occur at position *f*. Consequently, the lining at position *f* would feel but little the effect of the freely moving mass at that portion, as it would be protected by the balls having struck the lining once or twice at position *a* and now acting more or less as a secondary lining, and take the impact of the mass dropping between *a* and *f*.



Position of balls and material in (Fig. 1) slow-speed mill and in (Fig. 2) high-speed mill.

Lest we get too deep into this discussion, let us direct our attention to the case where slippage occurs. A smooth lining will allow the entire mass of balls and pulp to slip inside of the mill while in rotation. In order to get the same cascading effect as illustrated in position 1 or 2, the speed of the mill must be increased. The relation will substantially persist as regards the movement between the various zones, and also an additional movement with respect to the lining itself will occur. Here we get appreciably greater grinding effect on the lining, and incidentally greater lining wear. All other conditions remaining constant, we will obtain slightly better fineness. It is impossible to state just how much the increase of grinding amounts to, but it is more than likely not commensurate with the additional cost of operation due to the increased lining consumption.

Even when considerable slippage occurs, I am still of the opinion that the majority of grinding is done within the mass and not against the lining.

Any mill using the same kind of balls as liners shows a differential of almost 5 to 1 in consumption of balls to liners. Would this not indicate that the grinding is done within the mass? We must not forget, however, the fact that in high-speed operation there is more impactive rather than attritional grinding, and the impactive grinding causes less wear than the same result obtained by attrition. Would this in turn not account for the condition which occasionally contradicts practice, in that the lining consumption of a mill adjusted at relatively high speed is sometimes lower than the same mill operated under the same conditions, but at lower speed? HARLOWE HARDINGE.

New York, N. Y.

Corrected

THE EDITOR:

Sir—I suppose even in a matter of geography the *Engineering and Mining Journal-Press* would like to be accurate. In your issue of May 5, on page 787, referring to Mr. Rothwell you say—"He was born in Oxford, in what was then Upper Canada and is now the Province of Quebec." What you meant to say was "Province of Ontario," was it not? D. W. MCKILLOP.

Lynn, Mass.

William Fleet Robertson

BY T. A. RICKARD

THE test of a university is the men it sends forth. By that test McGill University ranks high, because, for example, it has given the mining industry several professional men of the highest character—and character counts more than any other factor in life. On another page we publish an interview with William Fleet Robertson, a graduate of McGill and an engineer identified for twenty-five years with the mining industry of British Columbia. It will be noted that Mr. Robertson was so fortunate as to start his career in association with three distinguished metallurgists: James Douglas, Henry M. Howe, and Edward D. Peters. To work with such men is to a young man a liberal education, and young Robertson made the most of it, so that today he bears the imprint as clearly to be read as clean type on white paper. He participated in the early development of copper-smelting practice and thereby gained a technical experience that enriched his professional life. It is amusing to note what small salaries were paid to the young men of the last generation and how they managed to live on them happily. Other times, other standards of living. A man's financial comfort is determined more by what he spends than by what he is paid, for good habits are more fixed than the rate of pay. Our friend moreover had the Scottish trait of thrift, so that, whatever he might earn, he took care not to get into debt, and thereby preserved his independence, which is a priceless boon to a virile character. His references to the technique of the metallurgical operations at Capelton and Constable Hook have a historic value and will be appreciated as such by the reader. It is a fine tribute to the management of a smelter to say that the fact that a thing has not been done is no argument against trying it, particularly if care be taken to make the trials on a small scale, not as a major operation of the plant. Another reference that will be appreciated is Douglas's distaste for secrecy. It will be remembered that he wrote a paper on secrecy in the arts, and all his life took the stand that human knowledge should be treated as an open book. When the big consolidation of the American Smelting & Refining Co. was formed, it was the plants that had secret processes that were shut down, because they were the least profitable. Secret methods usually are not worth copying, and the users of them are commonly the least efficient as managers. The knowledge of the individual is insignificant as compared with the sum of human knowledge, to which he is given a blank check; the least a man can do is to reciprocate with his own little contribution, and not to hoard knowledge for himself. Although Mr. Robertson had an interesting career as a metallurgist, it is by his work as Provincial Mineralogist of British Columbia that he is best known, for he has held that important post so long and with such honor as to be identified with it. He has lived to see the province develop into an important mining region and he has had the opportunity, of which he has availed himself with characteristic sincerity, of assisting and disciplining mining enterprise in the direction of clean business. The fraudulent promoter and the reckless wildcatter have no love for the Provincial Mineralogist, and he is respected for the enemies that he may have made in the discharge of his duties as a guardian of the mining industry in British Columbia.

WILLIAM FLEET ROBERTSON

No man can be interviewed without disclosing his character. Our friend obviously is a man of positive opinions and definite standards of conduct. The Scottish in him makes him severe toward wrong-doing; the gentleman in him makes him contemptuous of anything that is shabby. He is honest, of course; but he has also the rarer quality, intellectual honesty. Loyalty also. He is true to his friends. Once his friend, it is for keeps. His mind is orderly; therefore he is precise and explicit. He would have made a good lawyer but for being quick-tempered, so says his wife; and when she says it, she smiles. Moreover, perhaps he is too direct in his statements to have been a successful lawyer. He is a successful engineer and an efficient administrator—that more than suffices; he is a good citizen and a useful man in his day and generation; he holds the affection of many friends; what more could a man desire?

Screen-Sorting Analyses by Hydrostatic Separation

Specific Gravity Classification, Using a Heavy Liquid Such as Methylene Iodide, a Valuable Complement to Screen Analyses

BY SERGIO BAGNARA

Sergio Bagnara

THE elaboration of a plot containing all the data that will enable a metallurgist to have an exact idea of an ore about to be treated, and offering all the elements pertaining to the ore that will form the basis of his calculations for a flow sheet of milling, is the first step toward a correct solution of a great many problems of concentration. The information obtainable from a diagram of this nature plotted for various mill products is not merely of speculative interest but of real importance in actual milling practice. A screen analysis alone is a tabulation of figures, usually incomplete, often misleading, and gives no idea of the various mineralogical components of an ore or their relative amounts. Judging, for instance, of crushed-ore products only on the strength of the amounts remaining on a set of testing sieves is often as conclusive as guessing at the probable percentage of alcohol in home brew by the effect it has on a staggering pedestrian. Crushing, the *only* object of which, for the purpose of concentration, is the freeing of mineral from gangue, must be gaged only in the light of its mineral-freeing value, which, in turn, is expressed by a screen-sorting analysis.

SCREEN-SORTING ANALYSIS BY HYDROSTATIC SEPARATION

It is not possible, evidently, to make a screen-sorting analysis of much value unless it is obtained by a separation based on the specific gravity of the various products obtainable; and since mechanical—or rather hydrodynamic—separation is at best incomplete and therefore unreliable, hydrostatic separation is the evident solution. The use of heavy solutions for the hydrostatic separation of gangue from mineral in an ore is probably not new, but their systematic application, their mathematic analysis, and the standardization of results obtained are entirely unknown. These notes are published at the request of professional friends who had an opportunity of studying their importance and their industrial value in metallurgical investigation.

Mention of what is called the author's method, was made in two papers published in 1917 in the *E. & M. J.*, to which the reader is referred. The writer has been employing hydrostatic separation for technological and metallurgical purposes ever since 1906, when connected with the Cardiff Washed Coal Co. of Cardiff, Wales, for the rapid examination of coals for washery purposes. An apparatus was also designed by the writer and constructed by Townson & Mercer, of London, for the use of solution of calcium and barium chloride in the determination of mechanically separable matters in Welsh coals.

For metallurgical purposes, methylene iodide (CH_2I_2) has been used exclusively by the writer as the only heavy liquid that affords rapid and clean separation and comparatively easy handling. The only possible objection to its use is its rather high cost—about 17c. per c.c., or $5 per 100 gm.—but with proper care and intelligent manipulation most of it is recovered. If a laboratory is equipped with a fractional distillation apparatus, almost all of the costly solution can be recovered from its alcoholic washings. The writer uses the product of the Eastman Kodak Co. exclusively, as it has been found very satisfactory.

ORDINARY SCREEN ANALYSIS FIRST MADE

Methylene iodide is a colorless liquid of 3.35 specific gravity, the slightly pink color being due to iodine slowly evolved even at ordinary temperature. Its melting point is 4 deg. C. and it boils undecomposed at 180 deg. C. At higher temperatures it decomposes with liberation of iodine according to either one of the following equations, or more probably according to both:

$$\underset{\text{(Di-iodomethane)}}{2CH_2I_2} = \underset{\text{(Ethylene)}}{C_2H_4} + \underset{\text{(Iodine)}}{2I_2}$$

$$\underset{\text{(Di-iodomethane)}}{2CH_2I_2} = \underset{\text{(Diethyleniodide)}}{C_2H_4I_2} + \underset{\text{(Iodine)}}{I_2}$$

Di-iodomethane is soluble in alcohol, ether, and chloroform and is prepared by heating iodoform in alcoholic solution of sodium acetate and subsequent distillation.

A screen-sorting analysis is preceded of course by a screen analysis in the usual way. The writer advises the use of alternate screens, of the Rittinger scale, as results are just as accurate as using consecutive sieves. The coarse-mesh products must be well free from fine: it is therefore advisable to wash the coarse products after a thorough screening. The results obtained are tabulated and plotted in the usual way.

All the apparatus necessary for the manipulation of a hydrostatic separation consists of a few small beakers—25 and 50 c.c.—a couple of funnels, a thin glass rod, a small spatula, and a flat camel's-hair brush about half an inch wide. No special skill is required: the writer however recommends *extreme, scrupulous,* and even *meticulous* cleanliness of glassware. Beakers should be washed clean, rinsed in alcohol and ether, and dried thoroughly before using, as a trace of moisture is apt to try the patience of the experimenter to a high degree.

About 25 c.c. of methylene iodide is poured into a very small beaker and a weighed portion of the screened material—10 to 50 gm. according to the analyses to be made on the separate portions—is slowly poured over

the liquid. The separation is almost immediate, the heavy grains of mineral falling to the bottom of the beaker and the gangue floating on the surface.

The gangue is collected by means of the small spatula and camel's-hair brush and transferred to a separate small beaker. Stirring followed by settling will be found expedient at times. On coarse grains, up to and including plus-65-mesh product, the operation is performed rapidly, and when completed the iodide is recovered by filtration on Swedish filter paper that does not retain much liquid. A quick rotary motion of the beaker containing the separated products will aid in recovering the costly liquid and a centrifuge may prove useful at this stage. The separated products are washed in alcohol, either ethyl or methyl, or in chloroform or ether, several times if necessary, and if a distillation apparatus is handy the washings are saved for the recovery of methylene iodide. After washing, the products are dried and weighed separately. It will be found that if the operation is conducted carefully, not more than a few tenths of a per cent of the total weight of ore used will be lost in the manipulation even on amounts as large as 100 gm.

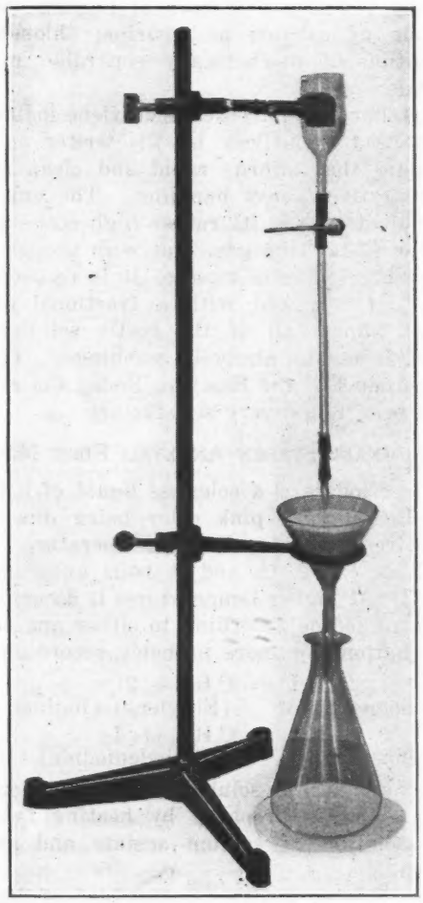


Fig. 1—Apparatus for hydrostatic separation of fine material

The washings in alcohol or ether are recommended even though not absolutely necessary, as methylene iodide can be driven off by evaporation. It is, however, necessary to watch the temperature closely, for if the decomposition is started, iodine will cake around the grains and greatly vitiate the results obtained. If this should happen, it can be remedied by pouring over the caked grains a hot 20 per cent solution of thiosulphate of sodium, followed by washing in hot water and drying.

For products as fine as minus 65 mesh and finer, the apparatus of Fig. 1 has been found by the writer the simplest and most practical. It consists essentially of a thistle-shaped centrifuge tube the tubular stem of which has been filed off, a piece of glass tubing of the same diameter as the stem and about 8 in. in length, and a glass plug made out of a short section of glass tubing. A funnel can be used instead of the centrifuge tube. The three parts of the apparatus are connected by two short pieces of rubber tubing, one of which, the lower, is closed by the plug and the upper by an ordinary pinchcock. The latter being closed in place, the apparatus is filled to about 15 mm. from the top with methylene iodide, and the fines are poured onto the liquid and stirred with a thin glass rod.

The mineral will slowly settle in the stem of the thistle or funnel, and gentle tapping will help the fine mineral collect in the stem. When the gangue is all floating at the surface, the pinchcock is opened and the downward flow of liquid will carry the mineral down the glass tube to the plug. Some more methylene iodide is added to the original level of the liquid in the thistle, the system settled at rest for a few minutes and the pinchcock replaced. The bottom plug is now carefully removed by pinching the rubber between forefinger and thumb, and the contents of the tube are emptied over a funnel fitted with Swedish filter paper. The operation is repeated two or three times until all mineral is separated from the gangue. When this point is reached, another funnel with filter paper is placed under the plug and the gangue allowed to collect on the filter paper. When all the iodide is filtered off, the apparatus is washed with alcohol or ether and the products are dried and weighed. The whole operation does not take more than thirty minutes for about 25 gm. of pulp. It may be at times necessary to refloat the separated mineral to clean it from particles of gangue mechanically drawn down the tube by the flow of liquid.

Tabulation of Results

The percentage of mineral to gangue on each size is readily obtained, and this, combined with the figures obtained in the screen analysis, is tabulated as in the complete example following. The cumulative plot of the mineral portion of the ore is drawn together with the cumulative curve of the ore. In ores where the relative amount of mineral to ore—ratio of concentration—is small, a larger unit may be used to plot the curve of the mineral: then the portion of the ordinate pertaining to the mineral will be read in the scale of the new unit used. Fig. 2 shows one of such plots, the figures of the tabulation offered as an example being used.

Ratio of Concentration

The figures given under "Separation" in the table express also the total ratio of concentration on each size and on the ore as a whole. Thus, for instance, the ratio of concentration up to 48 mesh is 300 : (49.7 + 53.0 + 59.6) or 1.84 : 1; and on the whole it is 100 : 55, or 1.82 : 1.

It is evident that the ratio of homothety of the curve Y_m (Fig. 2) to the curve Y_o represents, at any point, the relative cumulative percentage of mineral to the

ore. This ratio of homothety is *never* a constant in screen curves, but varies with the size. If we call

$$F_o(x) = y_o \text{ the equation of the curve } Y_o$$

and

$$F_m(x) = y_m \text{ the equation of the curve } Y_m$$

the value of this ratio is evidently expressed by

$$F_o(x)/F_m(x) = y_o/y_m$$

where x has the same value in both terms of the first member. The variation of the ratio is expressed by the derivative of the above or

$$\frac{d}{dx}\left\{\frac{F_m(x)}{F_o(x)} - \frac{y_o}{y_m}\right\}$$

If this is equated to zero the above expression gives the value of x—the mesh opening of the screen—for which the ratio $y_o : y_m$ is a maximum. As this maximum is reached only when the mineral is all freed from the gangue, the expression.

$$\frac{d}{dx}\left\{\frac{F_o(x)}{F_m(x)} - \frac{y_o}{y_m}\right\} = 0$$

gives mathematically the mesh opening of the sieve for which *all the mineral is freed from gangue.*

The use of the above formula is rather awkward in practice and involves the knowledge of much of that "math" that the average metallurgist does not know or prides himself in forgetting. The form of the equation $F_m(x) = y_m$, and its analogous one for the ore, is *never* algebraic and in its simplest form is at best transcendental on account of the logarithmic unit used, and could be reduced to the form $Ke^x = 1 : y_m$ where K denotes a constant and e is the base of hyperbolic logarithms. This expression as well as its derivative is also unwieldy.

It is permissible, however, to get to an approximate solution of the equation—although not mathematically correct in all the interval, it being correct only in correspondence with the ordinate representing the various screens used—if we assume that the interval between the mesh opening of two consecutive sieves is small enough to be considered an infinitesimal. We can then determine the actual value of $y_m : y_o$ for each sieve ordinate and take the arithmetical variation of this value (ratio of homothety) as the expression of its geometrical variation. At the mesh—or, better, in the interval—where this arithmetical variation is zero, *the mineral is all free.* Thus in the diagram given in Fig. 2, all the mineral is free at 48 mesh.

The tabulation of the ratio of homothety gives also the most valuable information as to the amount of mineral still combined with the gangue on previous meshes. In fact if at a certain mesh m, all the mineral is free from gangue, and D_{m-1}; D_{m-2} . . . ; D_{m-n} . . . are the values of the arithmetical variation of this ratio, then

$$D_{m-1} + D_{m-2} + \ . \ . \ . \ + D_{m-n} = D$$

expresses the percentage of mineral yet combined with gangue on the nth sieve preceding that where all the mineral is free. Thus, in the example furnished, 2.8 per cent of the 14-mesh mineral and 1.7 per cent of the 28-mesh mineral is still combined with the gangue. This information is of value in discussing the question of middling.

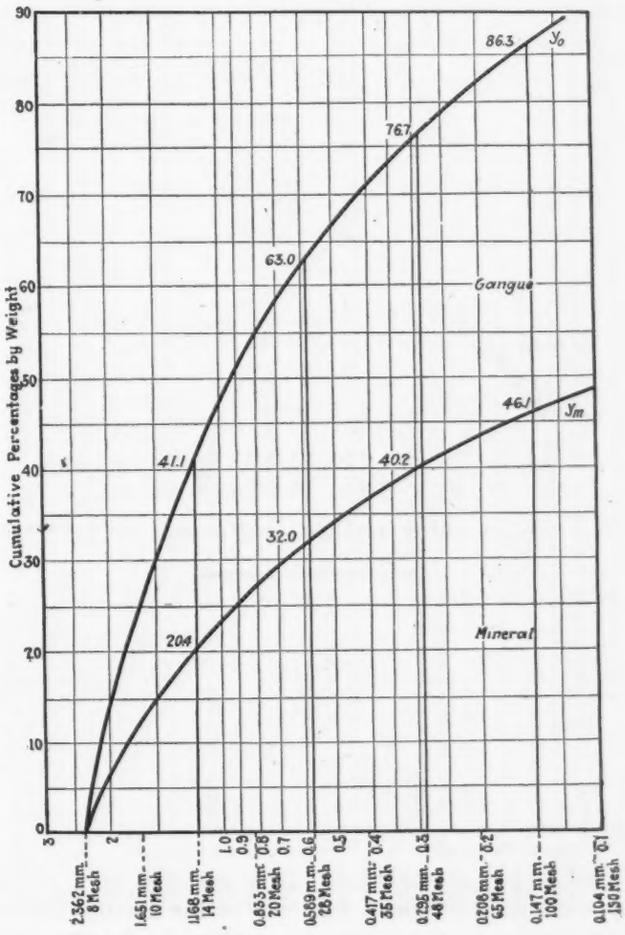


Fig. 2—Cumulative plot of mineral and gangue

Ratio of Homothety (Ym : Yo)		Variation of Ratio	
On 14	0.497	14 to 28	1.1%
On 28	0.508	28 to 48	1.7%
On 48	0.525	48 to 100	0.0%
On 100	0.525		

All mineral free at 48 mesh.

Tabulation of Screen and Hydrostatic Analyses

	Screen Scale Ratio 1.414 Openings				Screen Analysis of Ore			Separation Mineral + Gangue = Ore			Screen-Sorting Analysis Mineral + Gangue = Ore			Screen Analysis of Mineral		Screen Analysis of Gangue	
	Millimeters	Inches	Mesh	Diameter Wire Inches	Weight	Per Cent Weight	Cumulative	Per Cent	Per Cent	Per Cent	Per Cent	Weight	Cumulative	Per Cent Weight	Cumulative	Per Cent Weight	Cumulative
All pass.....	2.362	0.093	8	0.032	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Plus.....	1.168	0.046	14	0.025	15.0	41.1	41.1	49.7	50.3	100.0	20.4	20.7	41.1	37.1	37.1	46.0	46.0
Plus.....	0.589	0.0232	28	0.0125	8.0	21.9	63.0	53.0	47.0	100.0	11.6	10.3	21.9	21.1	58.2	22.9	68.9
Plus.....	0.295	0.0116	48	0.0092	5.0	13.7	76.7	59.6	40.4	100.0	8.2	5.5	13.7	14.9	73.1	12.2	81.1
Plus.....	0.147	0.0058	100	0.0042	3.5	9.6	86.3	61.5	38.5	100.0	5.9	3.7	9.6	10.7	83.8	8.2	89.3
Minus.....	.....	.....	100	.....	5.0	13.7	13.7	65.2	34.8	100.0	8.9	4.8	13.7	16.2	16.2	10.7	10.7
	Totals or Average.....				36.5	100.0	100.0	55.0	44.0	100.0	55.0	45.0	100.0	100.0	100.0	100.0	100.0

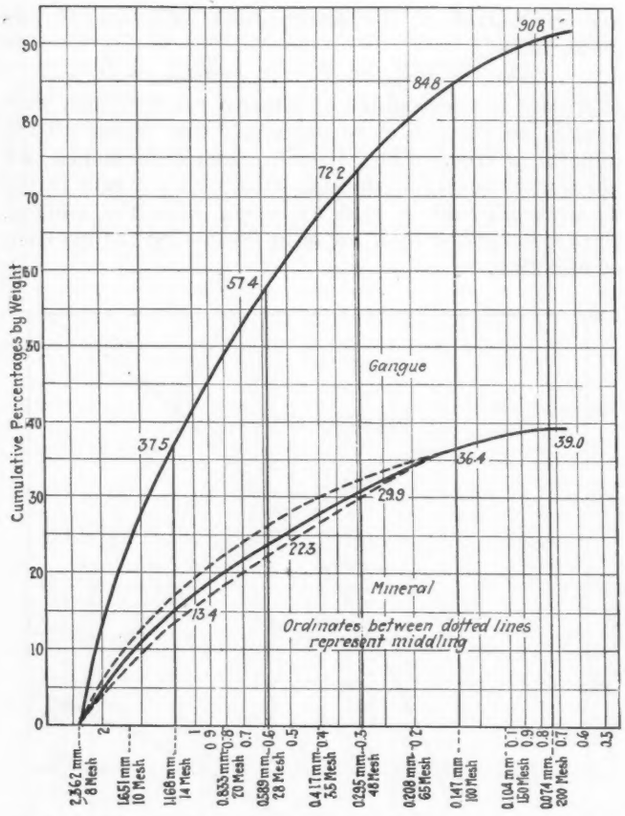


Fig. 3—Cumulative plot with corrections for middling

Screen-Sorting Analysis

Pass 8	Mineral	+	Middlings	+	Gangue	=	Ore
On 14	13.4		3.9		20.2		37.5
On 28	8.9		4.2		6.8		19.9
On 48	7.6		2.9		4.3		14.8
On 100	6.5		0.0		6.1		12.6
On 200	1.6		0.0		4.4		6.0
— 200	3.6		0.0		5.6		9.2
Total	31.6		11.0		47.4		100.0

Ratio of Homothety		Variation of Homothety, Per Cent	
On 14	0.385	.....	.....
On 28	0.405	14— 28	2.0
On 48	.420	28— 48	1.5
On 100	.429	48—100	.9
On 200	.429	100—200	0.0

All mineral free at 100 mesh.

It is evident that some such particles of a total specific gravity lighter than that of the floating liquid are present in the gangue as obtained by floating the ore over heavy solutions. If we call p the specific gravity of the gangue and P the specific gravity of the mineral, and if x is the percentage of mineral in a grain of middling that will float with the gangue, the analytical condition expressing that such grain will float is evidently

(a) $$xP + (1 - x)p = D - h$$

where D is the density of the separating liquid and h is a number. Therefore,

$$xP + (1 - x)p = D$$

is the equation of equilibrium of such a piece of middling in the floating liquid.

The actual value of P and p are known for each component of the piece of middling under consideration, and their numerical value can be substituted in the equation. Thus, for instance, for quartz and galena the equation of equilibrium of a piece of middling in methylene iodide becomes

$$x\,7.45 + (1 - x)2.65 = 3.35$$

which gives

$$x = 0.1458$$

The metallurgical interpretation of the above is: *A piece of quartz-galena ore, containing 14.58 parts of mineral and 85.42 parts of gangue (12.62 per cent Pb) is in equilibrium in methylene iodide.* If, then, the floating liquid be diluted to slightly above the specific gravity of the pure gangue—which is easily done by adding carbon tetrachloride to the methylene iodide—and refloat the portion separated as gangue when using straight iodide, all middlings corresponding to the condition expressed in (a) will fall to the bottom of the beaker, separated from the clean gangue. These can be weighed separately and results found in the first separation corrected accordingly.

Going back to the expression (a) it is also evident that all pieces for which

(b) $$xP + (1 - x)p - h = D$$

will be found with the mineral of the original separation. However, without going through a second separation for the determination of the value of h, the analysis of the variation of the ratio of homothety has given us that n : 100 of the total mineral is still combined with the gangue at a given mesh, and the chemical analysis reveals the presence of m : 100 parts of gangue in the mineral; therefore we are in a position to calculate, not only the amount of middling in the mineral but also its grade, or metal contents. For example, if on 14 mesh the cumulative percentage of mineral is 14.75 and the ratio of homothety gives 2 per cent as combined with gangue, if the analysis shows 0.8 per cent SiO_2, then

2 per cent of weight on 14 mesh	0.295
0.8 per cent SiO_2	0.118
Galena combined	0.177

Composition of middling:

Galena 177 parts (153 parts Pb)
SiO_2 118 parts
Pb 51.95 per cent

The amount of middling found in the gangue plus the amount of middling found in the mineral gives the total amount of middling on that particular size. This can be plotted on the diagram obtained in the first separation, and Fig. 3 gives an idea of a complete diagram.

Hydrostatic separations with the aid of heavy liquid should be made more frequently and should be generalized, as they have wide application in metallurgical practice. The measure of the separating efficiency of a concentrating table, which is expressed in terms of free mineral left in the tailing, is easily performed with methylene iodide separations. So is the determination of the washing efficiency of a table, given in terms of tailing or sand left in the concentrate.

The selective action of hydraulic classifiers is equally a simple matter to determine with two separations, as well as many other matters. Many grinding problems —one of which was treated in the 1917 Milling Number of the *E. & M. J.*—are brought to a mathematical solution by hydrostatic separations. The often laborious determination as to whether gold and silver in a sulphide-bearing ore are associated with the gangue or the sulphides, and in what proportion, is easily and correctly made with one separation and two assays. The method may be found of value in the determination of the specific gravity of rocks, when several dilutions of methylene iodide are available: this determination is then performed without the use of the balance and in an extremely rapid way.

Mining in France—1700-1750

Chemists and Metallurgists Close Students of Eighteenth Century Practice—Pluche, Reaumur, and Hellot Described Technology of the Day—Oxidation by Fire Not Yet Understood

BY H. H. MANCHESTER

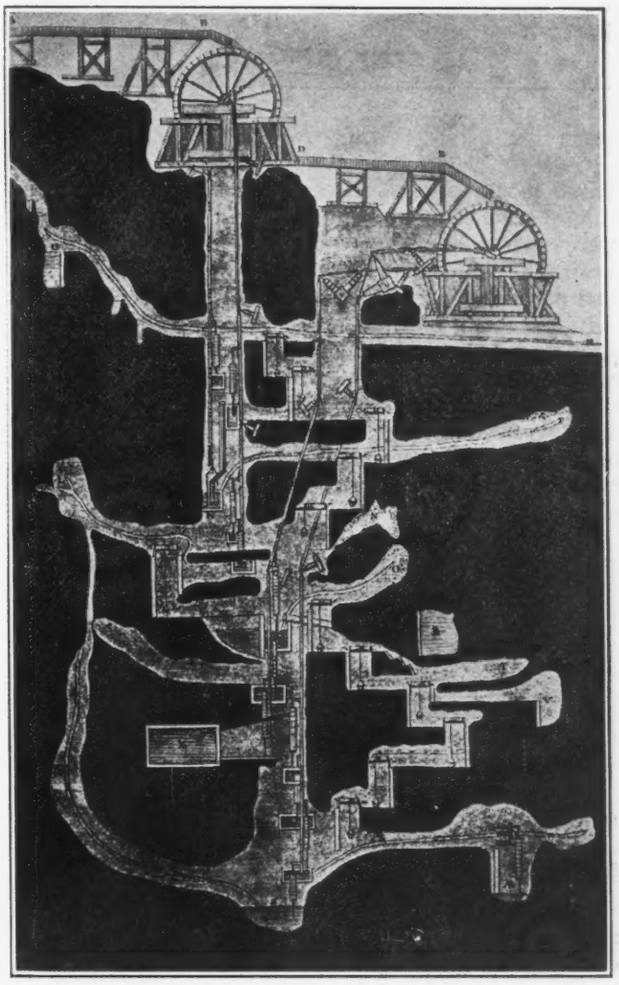
IN THE EIGHTEENTH CENTURY in France strong efforts were made with the encouragement of the king and the court to gather and systematize the knowledge of the period. This led to important sets of volumes and monographs on the sciences and trades. Some of these were illustrated with copper plates, and furnish an excellent résumé of the most generally accepted facts and most highly recommended methods of the time. In 1736, for example, Pluche produced "Le Spectacle de la Nature," which touched upon the most important phases of the knowledge of nature, and had considerable to say on mining and metallurgy. It contained no illustrations on these subjects, but these may be collated from other sources.

Although blasting with powder had been introduced in the seventeenth century, the pictures illustrate the fact that fire was still a commonly accepted method of softening or loosening the rock in mines.

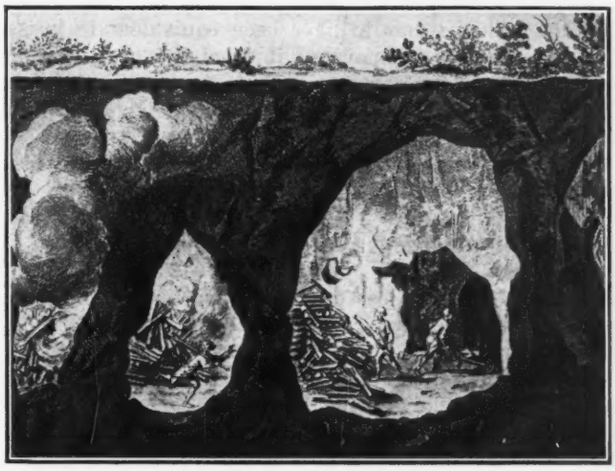
Water power and animal power were still the main reliance for draining the mines. Attempts at steam engines for the purpose had already been made, but they were still inefficient and costly. For transporting the ore, about the only important improvement was the use of cars on rails, which were still pushed by boys or women. When the ore was brought to the bottom of the shaft, it was hauled up usually by animal power, though water power and tread wheels were also employed.

The engravings themselves depict the methods of sinking the shafts, the implements in use, and many other details so clearly as not to demand further description.

Pluche gives a fairly detailed résumé of the metallurgy of gold. To separate the gold from the superfluous matter, they bruised the ore with iron pestles, and reduced it to powder in the stamping mill. Then they sifted it through a fine copper sieve and mixed it with mercury and water. The resulting paste was kneaded in wooden troughs for two days under a hot sun. After the mercury had amalgamated with the gold, they washed away the dirt with water. Fire was then applied to drive away the quicksilver, but Pluche omitted the details.



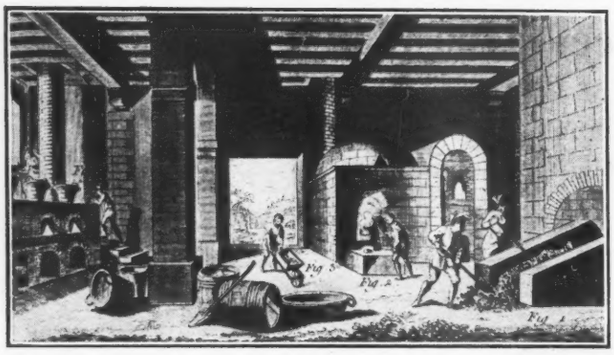
An eighteenth century drainage system



Softening rock by burning wood

The gold was thereupon refined in one or more of four ways—by antimony, by a sublimate, by an acid, or by lead and ashes. The antimony was fused with the gold, combining with the other metals and letting the gold fall to the bottom of the melting cone, the antimony passing off in fume. The refiners, however, avoided this method and also the one using sublimate where possible, because of the poisonous vapors. The sublimate, where used, was a mixture of mercury and "spirits of sea salt."

The favorite process of refining was through "aqua fortis," which then meant "a liquor composed of spirits distilled from nitre and vitrol." This dissolved the silver, copper, and other metals, and left the gold without alteration. To refine eight ounces of gold they



Metallurgical furnaces

mixed it with several times that much silver in a cone-shaped crucible of clay and powdered stone. The metals were melted and poured into water, separating into grains, to which they added a pound of "aqua fortis" and put on the fire, luting or covering the pot with clay. After an hour the liquid was poured off. This operation was repeated once or twice more before the gold was considered pure.

The silver from the "aqua fortis" was recovered by heating it in earthen pans with seven or eight times as much spring water and several ingots of red copper, the "aqua fortis" seizing the copper and letting the silver precipitate.

The extraction of bismuth

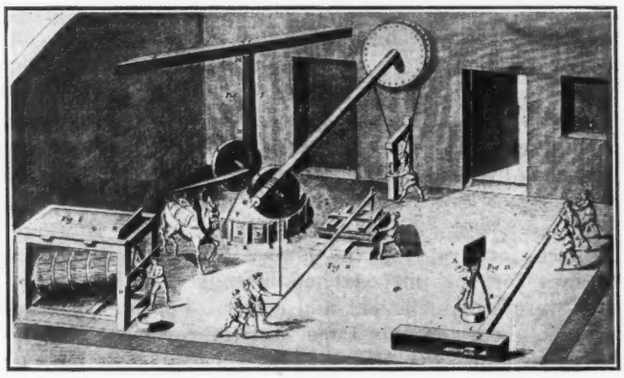
In refining with lead, the lead was seemingly lost along with the crucible. This method was used in assaying silver, but in assaying gold a dram of it was melted with two of silver, the mass beaten into a thin plate and the silver dissolved out of it in "aqua fortis" over a fire.

Silver was extracted from its most common ores by amalgamation with mercury. After stamping, mixing with mercury, and kneading, as much of the mercury as possible was strained off through a woolen bag to save it, and the rest evaporated by fire. The remainder was refined with lead.

At that time the ratio of the value of silver to that of gold was one to fourteen.

The French Iron Industry in the Eighteenth Century

In France, iron mines were taken over by the government, and the king appointed officers to dig the ore



The preparation of zinc from "calamy"

wherever they found it, paying the owners of the land about three cents a ton in royalties.

In preparing the iron ore for smelting, the so-called "stone-ore" was broken in the stamp mill, while the iron sand was washed in a tub ten feet square and two feet deep. This was constantly stirred and pounded, while a steady stream of water carried away the earthy particles. A furnace yielding around three thousand pounds of cast iron in twenty-four hours, required about fifteen tons of washed ore, and about sixty puncheons of coals. Coals then meant charcoal, for the process of smelting with coal or coke was not yet a success.

Copper was classified as of two sorts, red and yellow, but the yellow seems to have been equivalent to brass. They purified and separated it from the ore, whether of earth or stone, by frequent fusions over the fire. This produced red copper, the best quality of which came from Sweden.

To produce yellow copper, or brass, they fused a mass of copper with an equal quantity of "calamy" or *lapis calaminaris*. It was recognized that the copper was considerably augmented in quantity by the fusion, but the product was still considered a variety of copper. Although this was less ductile, it was less subject to rust, and the ductility was restored by softening it with a mixture of lead.

By mixing copper with a little antimony and tin it was made suitable for the casting of cannon and mortars. By fusing it with a double quantity of tin—that is, by adding twenty-five pounds of tin to one hundred of cast copper—it became very sonorous, and was

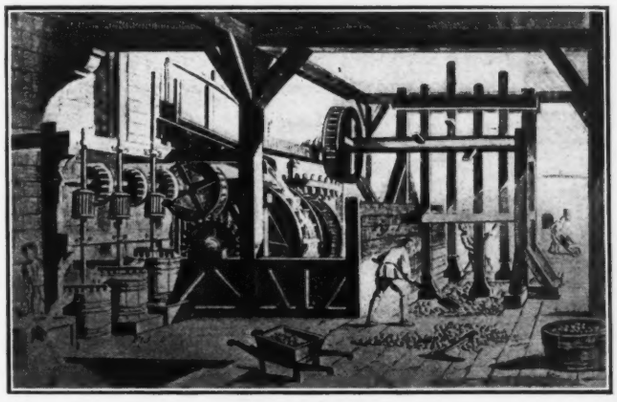
used by the founders for the casting of bells. It is rather curious that Pluche in his account of copper alloys does not mention bronzes by name, but refers to them rather as cannon metal or bell metal.

Science of Chemistry Officially Recognized

In 1699 the Academy of Science had established a chemical branch, so that, from then until the Revolution, chemists were officially recognized in France. Although much of their attention was absorbed by other matters, a portion of it was naturally turned to metallurgy.

Throughout the period under discussion, the most potent and basic chemical theory was that of phlogiston, which may be said to have been founded by Stahl at least as early as 1702. This, it will be recalled, was the rather curious deduction that phlogiston was the element of fire which was a part of all combustible things, and that combustion consisted in driving phlogiston out of the compound. Thus they made combustion a separation, rather than a combination of elements.

This fundamental error led to an entirely wrong classification of elements. They thought, for example, that red lead was the element, and lead the combination of it with phlogiston, and that "calamy" more nearly represented the element than zinc, which was obtained from it through combustion. As one of the books of the time put it, phlogiston, or fire, was distributed in great abundance among the vegetables and minerals throughout the world, but was particularly strong in sulphur. Water, for example, was thought to absorb fire from burning wood, much as a sponge does water, and thus stop the burning of the wood.



Stamping and washing gold ore

Despite these twisted ideas several of the French chemists made important advances in metallurgy. Reaumur (1683-1756), who was admitted to the Academy of Sciences in 1708, not long afterward wrote an account of the rivers in France yielding gold, and of the methods of extracting it.

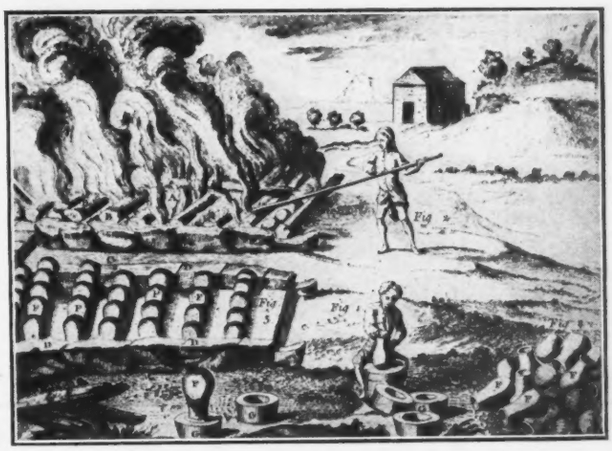
At that time practically no steel was being produced in France, but in 1722 Reaumur investigated the art of making it from iron. He thought that steel was iron impregnated with sulphurous and saline matter, the word sulphurous being more or less equivalent to fiery. The method he recommended was to place four parts of soot, two parts of charcoal, two of wood ashes, and one and one-half of common salt, about iron which was to be kept red hot until it turned to steel. The method was a success, and several steel mills were established to use the processes. Reaumur himself received a pension of twelve thousand livres, or three thousand dollars, on account of it.

A representation of the various details of a French mine

He was responsible also for the first important tinplate works in France. The French had been unable to make the tin adhere to the iron, on account of the scales on the iron. Reaumur steeped the iron plates in water acidulated with bran, let the plates rust in stoves, rubbed off the rust with sand, and then plunged the plates into the melted tin. Several establishments were founded, which long used this method with success.

Another of the chemists, who devoted himself in part to metallurgy was Hellot (1685-1735). Encouraged by the phlogiston theory, he tried to decompose zinc, and, although unsuccessful, learned considerable about it. In 1745 he was appointed to examine the processes used in refining gold and silver at Lyons, and, although he caused no radical changes, he made the methods much more precise. Thereupon he was commissioned to examine the mines in France, and to assay their ore. This led to his preparation of two volumes on assaying and metallurgy, the introduction to which was a description of the French mines. These volumes, which were published in 1750 and 1753, were well illustrated with engravings, some of which are here reproduced.

In 1763 one of the mines at Brianson suffered from a tremendous explosion of fire damp which killed all in the mine. Hellot was one of those sent to make an investigation, the result of which was a better knowledge of the necessity and methods of ventilation.



The extraction of mercury

Trend of Metallurgical Practice on the Witwatersrand

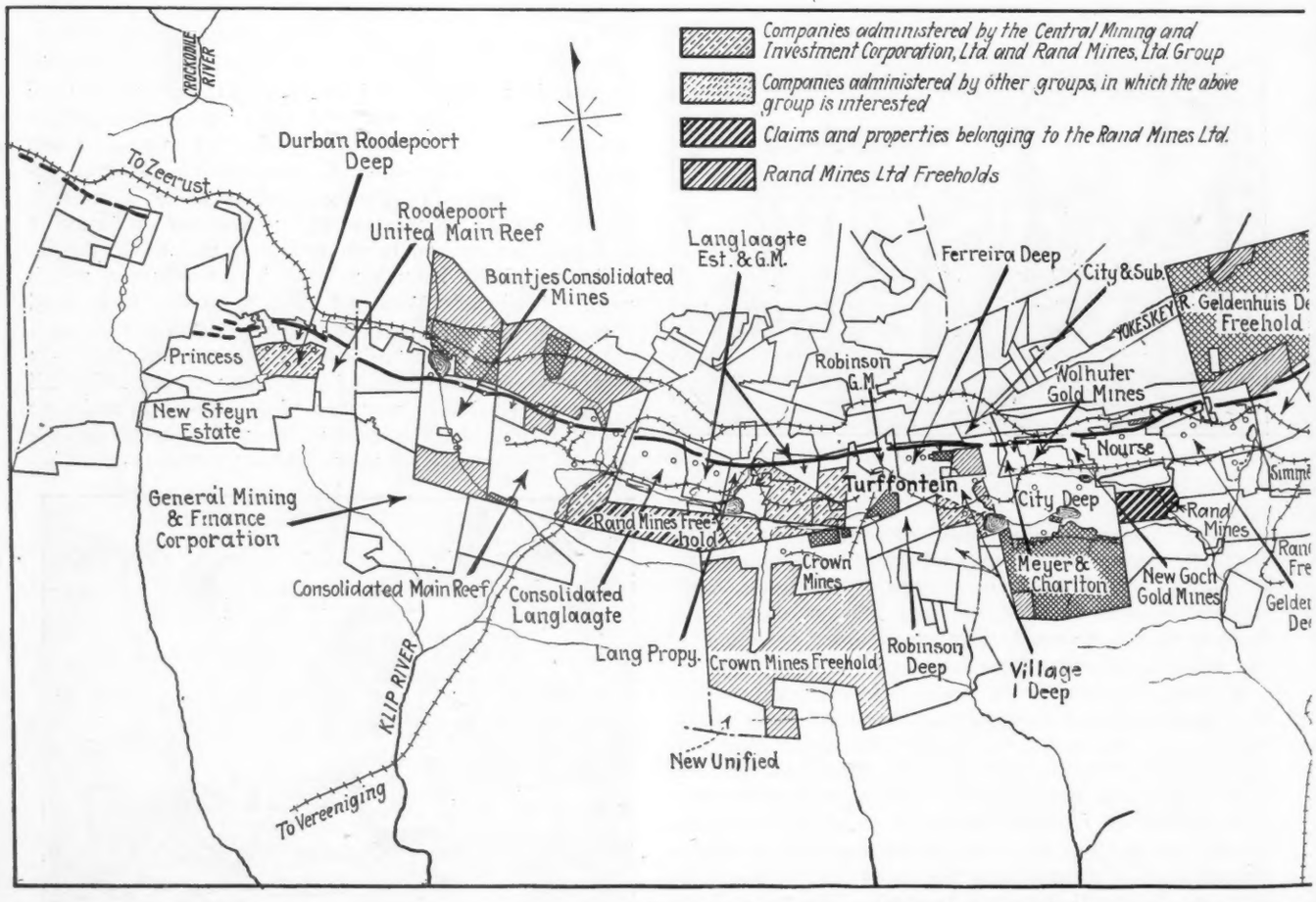
Conservatism and Efficiency—Fine Grinding or Separate Treatment—Metallurgy and Economics—Statistics—Comparison with Recent American Practice—Corduroy Concentration

BY A. W. ALLEN
Assistant Editor

THE METALLURGISTS of the Witwatersrand gold field have often been accused of failing to move with the times—of a conservatism evidenced by the retention of the stamp mill and the amalgamation process and the leaching of sand. All-sliming was advocated not long after its introduction elsewhere for refractory ores, but without appreciable effect on current practice.

Between 1902 and 1921 (inclusive) nearly 300,000,000 tons of ore was treated by standard methods at Johannesburg and vicinity. The extractions and recoveries obtained at the majority of the plants have been published with commendable frankness in the company statements, and the figures may be considered to justify the retention of the methods used. Latterly, however, it has been difficult at some of the newer mines of the Far East Rand to obtain good extractions; the metallurgical results at the Springs mine are particularly noticeable on account of high residues. It is being realized that the ores in that region are more refractory, and this has led to a refocusing of attention on the all-sliming process.

Unfortunately, however, recent metallurgical developments have been misunderstood by some writers: the changes adopted and proposed in the Far East section have been viewed as heralding a radical alteration in the treatment of Rand ores. Several repetitions have occurred of a statement that appeared in the *Mining Journal* last year to the effect that certain ores which previously yielded 70 per cent by amalgamation now yield from 35 to 40 per cent, quoting this fact in support of the plea that the older process should be abolished. The arguments in favor of the all-sliming process have been resuscitated, and the method has been featured as the salvation of a waning gold industry. In this respect it is pertinent to note that, despite the conservatism of metallurgical practice, the gold output of the Transvaal, as a percentage of the total world's production, increased steadily between 1912 and 1921 from 40 to 52 per cent.

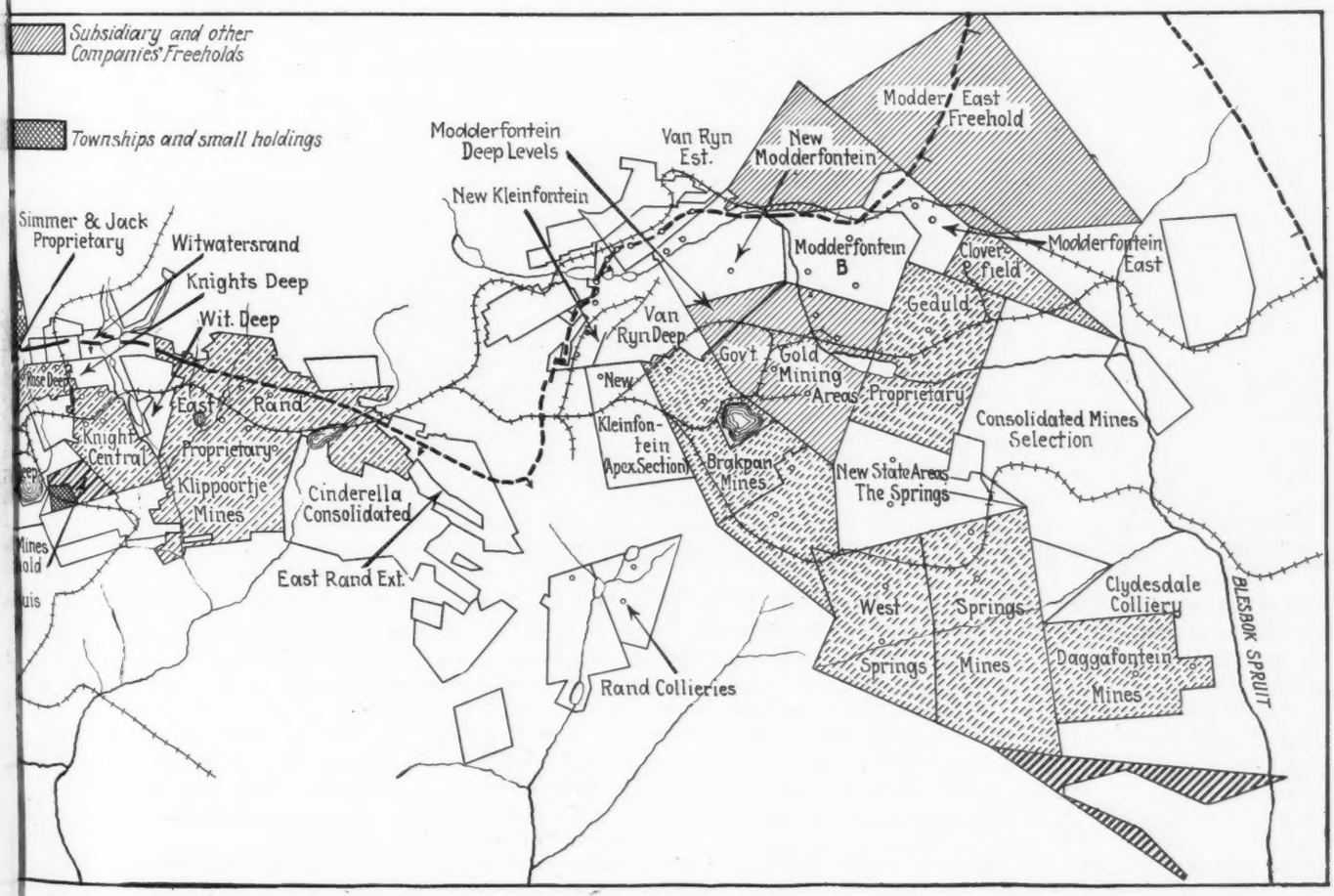


General plan showing boundaries of holdings of the important

Little cause exists for uneasiness in regard to metallurgical practice on the Witwatersrand. The metallurgical returns for 1921 from official sources, dealing with thirty-five important properties, have been compiled and are given herewith. These are of especial interest, for they constitute the only normal results that will be available until the figures for 1923 are published, because the strike and revolution of 1922 disorganized operations. From these results it would seem that little alteration has occurred in the character of the ores of the Witwatersrand as a whole so far as the percentage of gold recovered is concerned. In 1912 it was 63.5 per cent; in 1921 it averaged 63.4 per cent or thereabouts. The tonnage of ore treated in the form of fine pulp was increased, however, in large measure because of the improvements made during recent years in the mechanical handling of slime; finer grinding becomes more and more justified as slime-filtration methods become cheaper and more efficient. Further, the ore has doubtless become more complex at depth in some of the mines; hence it is logical that the amount slimed should increase, fine grinding being carried to such degree that subsequent treatment yields the best net results and the highest net profits.

Alfred James, in the January, 1922, issue of the *Mining Magazine*, points out that the recovery by cyanidation from normal slime may differ considerably from that obtainable from ground quartz. Whether all-sliming the ores of the Witwatersrand would result in an appreciable increase in South Africa's output of gold is open to question, although it is more than probable that lower residues might be obtainable in the Far East Rand. W. Cullen, who read a paper on March 6, 1922, before the London section of the Society of Chemical Industry, claims that "on one point practically everyone is agreed nowadays—viz., that in the long run it pays to grind the ore as fine as possible." This would appear to some to be a dangerous generalization, the acceptance of which would eliminate many prosperous but low-grade mines that contribute largely to the world's production of gold. However, the author doubtless meant to refer only to the Witwatersrand; but, even there, metallurgists seem unable to agree as to the advisability of such procedure. The problem of separating all but an insignificant proportion of metal-bearing solution associated with ground gangue becomes more and more insistent as comminution proceeds. Those who have followed the progress made in the chemical industry in the artificial preparation of colloids by fine grinding, forming a phase of matter that is tenaciously absorbent of liquid and highly adsorbent of dissolved salts, will realize that there may be limits to the degree to which fine grinding should be carried when the gangue is kept in contact with a solution of gold.

"The excellent results" being obtained on the Witwatersrand, says Mr. Cullen, "have not been brought about by radical departures, but by slow persistent effort." This is a compliment to South African metallurgists that is well deserved. "It would be difficult



gold properties on the Witwatersrand, in South Africa

to conceive any process," he adds, "which could improve on the figures quoted." Such arguments, supplemented by the data given in the accompanying statement, should convince the most sceptical that standard treatment, especially the modernized adaptation seen in the plants of the Modder B. and the New Modderfontein mines, is logical from the metallurgical standpoint and sound from the economical one. All-sliming may be favored when the ore shows an alteration from the normal; but the acceptance of the "new metallurgy" on a few mines on the Far East Rand cannot yet be interpreted as heralding any epoch-making change in procedure, either on the Witwatersrand or elsewhere. It is significant to note that the outstanding feature of the two large plants completed in the United States in 1922—the Homestake new South mill and the plant of the United Comstock Co., each with a capacity of about 2,000 tons per day—was the adoption of sand leaching. At the United Comstock, the ore contains an economic amount of silver, and amalgamation is therefore not indicated; but milling in water is practiced in both these new installations.

and less temptation to theft. Further research is planned to determine the practicability of substituting all-cyanidation for amalgamation and cyanidation, for the treatment of the concentrate.

It is interesting to recall, as Mr. Wartenweiler's statistics show, that the recovery of gold in blanket concentrate varied considerably at the New Modderfontein mill, according to whether or not amalgamation as a preliminary impoverishing treatment was adopted; but the results referred to the treatment of an unfinished product containing free gold and pyrite. With straight cyanidation the extraction was 89.5 per cent; with a combined amalgamation-cyanidation treatment it was 99.7 per cent, the recovery by amalgamation being 79.3 per cent of the total. A laboratory extraction by amalgamation implies the practicability of recovering an equivalent proportion in mill operation; but considerable variation in result may occur between a laboratory extraction by cyanidation and a recovery in practice by the same process. Hence the difference in extraction results quoted may not cover all the advantages in favor of the double treatment.

Metallurgical Results of 35 of the Principal Gold-Mining Companies of the Witwatersrand District of South Africa

	Tons Milled	Yield, Ounces	Recovery: Amalgamation Ounces	Amalgamation Per Cent	Cyanidation Ounces	Cyanidation Per Cent	Gold Content: Ore, Dwt.	Pulp (a) Dwt.	Residue, Dwt.	Assay Extraction	Actual Recovery
Crown Mines	2,177,000	643,005	470,099	73.1	172,906	26.9	6.104	1.785	0.274	95.6	96.8
Government Gold Mining Areas	1,625,500	665,819	370,403	55.8	295,416	44.2	8.570	4.013	0.421	95.08	95.58
East Rand Proprietary	1,506,000	396,285	227,225	57.3	169,060	42.7	5.525	2.507	0.292	94.7	95.3
Randfontein Estates	1,461,000	427,893	268,484	62.7	159,409	37.3	6.141	2.466	0.272	95.56	95.38
New Modderfontein (b)	1,083,000	527,477	347,855	66.0	179,622	34.0	9.960	3.536	0.293	97.2	97.8
City Deep	995,100	418,441	295,258	70.6	123,183	29.4	8.695	2.761	0.316	96.4	96.7
Robinson Deep	695,200	209,716	131,973	63	77,743	37	.....	.....	.....	.....	.....
Modderfontein B	687,500	361,866	206,449	57.1	155,417	42.9	10.870	4.864	0.331	96.9	96.9
Brakpan Mines	659,800	285,227	197,983	69.4	87,244	30.6	8.948	2.947	0.282	97.6	96.6
Rose Deep	644,500	158,170	98,473	62.3	59,697	37.7	5.236	2.180	0.324	93.8	93.7
Van Ryn Deep	611,400	327,007	226,285	69	100,722	31	10.976	3.574	0.388	96.46	97.46
Village Deep	581,800	184,217	115,667	62.8	68,550	37.2	6.595	2.619	0.38	94.3	96
New Kleinfontein	581,060	159,009	103,380	65	55,629	35	5.784	2.226	0.311	94.7	94.6
Geldenhuis Deep	573,450	153,450	98,439	64.1	55,011	35.9	5.624	2.191	0.325	94.3	95.2
Consolidated Main Reef (b)	561,800	196,704	144,250	73.3	52,454	26.7	7.389	2.254	0.368	95	94.8
Geduld Proprietary	537,800	189,986	85,563	45.0	104,423	55.0	7.662	4.437	0.541	92.9	92.7
Modderfontein Deep (c)	509,300	280,355	176,222	62.8	104,133	37.2	11.303	4.380	0.323	97.2	97.4
Nourse Mines (b)	508,700	160,499	103,155	64.3	57,344	35.7	6.586	2.530	0.286	95.8	95.8
Springs Mines	484,750	213,699	95,044	44.5	118,655	55.5	9.369	5.448	0.578	93.83	94.1
Consolidated Langlaagte	484,600	144,629	104,460	72.2	40,169	27.8	6.224	1.913	0.243	96.1	95.9
Langlaagte Estate	479,300	147,197	94,655	64.3	52,542	35.7	6.453	2.503	0.282	95.63	95.18
Robinson Gold	460,300	93,024	48,684	52 3	44,340	47.7	4.343	2.228	0.295	93.2	93
Witwatersrand Gold	448,300	117,734	87,929	74.7	29,805	25.3	5.505	1.582	0.269	95.11	95.4
West Rand Consolidated	389,700	111,025	71,817	64.7	39,208	35.3	6.152	2.466	0.385	93.74	92.59
Van Ryn Gold (b)	381,230	108,867	75,541	70	33,326	30	.....	.....	.....	.....	.....
Wolhuter Gold (d)	378,600	95,039	60,450	63.6	34,589	36.4	5.296	2.103	0.311	94.1	94.8
Ferreira Deep (e)	375,700	123,405	91,250	73.9	32,155	26.1	6.826	1.968	0.369	94.7	96.2
Durban Roodepoort Deep	317,900	107,994	71,284	66	36,710	34	7.092	2.607	0.378	94.6	95.8
Roodepoort United	259,650	52,128	38,958	74.8	13,170	25.2	4.34	1.34	0.25	94.3	92.5
New Primrose	256,700	55,520	39,561	71.3	15,959	28.7	4.659	1.567	0.29	93.8	92.8
New Goch	196,200	45,063	29,538	65.6	15,525	34.4	5.25	2.23	0.42	92.07	87.67
Transvaal G. M. Estates (g)	186,615	60,460	28,846	47.8	31,614	52.2	.....	.....	.....	....	....
Meyer & Charlton (f)	163,200	97,059	34,528	35.4	62,734	64.6	12..05	7.84	0.349	....	....
New Unified	133,700	30,102	18,277	61	11,825	39	4.751	2.017	0.262	94.48	94.75
Aurora West United	122,410	33,174	23,807	71.7	9,367	28.3	5.960	2.00	0.30	95	90.9
Tons milled	21,518,765	.....	.....	....	.....	....					
Total gold yield, oz		7,381,245	.....	.....	.....	....					
Recovery by amalgamation, oz			4,681,589	.....	.....	....					
Recovery by amalgamation, per cent of total			.....	63.4	.....	....					
Recovery by cyanidation, oz					2,699,656	....					
Recovery by cyanidation, per cent of total					.....	36.6					

(a) After amalgamation. (b) Year ended June 30, 1921. (c) Iridium reported in ore. (d) Year ended Oct. 31, 1921. (e) Year ended Sept. 30, 1921. (f) Plant treats purchased concentrate. (g) Year ended March 31, 1922. All other figures refer to year ended Dec. 31, 1921.

Most recent developments in the metallurgy of the Witwatersrand compel recognition of the fact that it is the underlying principle of impoverishment of pulp before cyanidation, rather than the application of any particular process such as amalgamation, that justifies attention and research. In a recent issue of the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, F. Wartenweiler, the president, detailed the results obtained by the adoption of concentration on corduroy mats, followed by the "finishing" of the product on Wilfley tables, the amalgamation of the resultant free gold in a barrel, and the regrinding and cyanidation of the tailing. The advantages of the change include a reduction in the total consumption of mercury

These recent developments in preliminary impoverishment of gold ore remind me that a quarter of a century ago opinion was divided in Western Australia as to the merits of amalgamating gold in the grinding pans. At the Kalgurli mill it was customary to allow the concentrate to collect, and it was afterward amalgamated and cyanided; elsewhere, amalgamation was practiced during grinding. However, there was agreement as to the importance of reducing the gold content of the pulp before cyanidation was begun.

The recent investigation described by Mr. Wartenweiler is pregnant with possibilities, as indicating the value, or the reverse, of the separate treatment of the high- and the low-grade portions of an ore. The prac-

tice of concentrating as much as possible of the gold in a small bulk of material, followed since the early days of the cyanide process, permits the introduction of refinements in subsequent hydrometallurgical operation to insure an almost complete recovery of dissolved metal, by repeated or more efficient displacement methods, the cost of which might be prohibitive if applied to all the ore milled. Thus, the segregation of the ore into a large bulk of low-grade material and a small bulk of high-grade material permits the application of the same extraction method to each portion, but with a better chance of obtaining a low average residue. Or the low-grade portion may be discarded, as witness the excellent results obtained in 1922 on 81c. ore at the Alaska Juneau mill by breaking, sorting, crushing and concentrating, followed by the amalgamation of the concentrate.

In ordinary practice, an additional advantage of the segregation outlined earlier in this paper is that the tailing from the high-grade portion is usually allowed to join the main pulp stream and is then subjected to additional chemical treatment at an almost negligible cost. Attention may be called to the mechanical efficiency of displacement when finely ground material is treated on continuous-operation vacuum filters, repulped and refiltered, the process being worked in countercurrent fashion. The equipment cost is unimportant if a comparatively small tonnage is treated, although such a scheme is seldom justified for the treatment of ordinary ore; but the advantages of continuity of operation and mechanical efficiency of displacement when a finely ground concentrate product is being handled might well attract more attention by those who realize the importance of an almost complete extraction of dissolved metal from high-grade pulp.

The Silver Situation in China

Recent mention has been made in the *Engineering and Mining Journal-Press* of the debased silver coinage of many of the principal governments, and also of the seigniorage which reverts even to the United States government through the purchase of silver at the market price, or even at $1 an ounce, and its subsequent sale to the public at around $1.39 per oz. by issuance as coins. The honest Chinese seem to have taken a leaf from the civilized, in a manner of speaking, countries, as is shown by the following excerpt from the weekly bulletin of Samuel Montagu & Co., of London:

"The chairman of the Hongkong and Shanghai Banking Corporation in his speech at the last annual meeting alluded to the amusing competition between Chinese Mints, whose chief aim being to obtain a profit, are apt to disregard such mere details as the fineness and weight of coins. He stated that the Anhui Mint produced large forgeries of the Canton Mint's 20c. pieces which were seized by the Maritime customs and prohibited from transit from one port to another. The chairman added that if Shanghai sycee were to disappear, chaos would come. Each mint would vie with the other in turning out debased dollars and we might in course of time see a coin that had in it more copper and foreign matter than silver. So, until there are seriously administered mints in China, it is absolutely essential to hold on to honest Shanghai sycee.

"*The North China Herald* thus comments upon the depreciated currency in certain provinces of China:

"'Mints have always been a source of revenue to provincial officials, but while the potentates were content with a modest and moderate squeeze, coins a little under value, if not too numerous, were accepted as notes are accepted, and no one suffered. It was an official, lately Tuchun of Hupeh, who set the fashion of turning out scandalously low-value coins in enormous quantities, thereby foisting them upon the local public, and shipping them, freight free, into provinces near and far, for paying his troops with them, and for purchasing good silver dollars to stow away in his personal strong box. . . . One of the weak spots in this game is that after a time the depreciated subsidiary coinage begins to come back into the provincial treasury in the form of taxes. There is only one remedy for this from the official point of view and that is to pay everything in bad money and collect everything in good. Nothing is calculated to make an official more unpopular than this. Every one from the farmer to the big employer of labor feels it at once and resents it with a ferocious resentment, for where the small coinage has depreciated as it has in Hupeh, it is equivalent to a doubling or trebling of taxes.'"

Jarbidge, Nev., Described in New Bulletin

Jarbidge, a leading gold-producing camp of Nevada, is one of the younger mining camps of the state, ore having been first discovered there in 1909. It has, however, produced nearly $2,000,000 worth of gold. It continued to produce steadily during the period of high war prices, when most of the other gold camps of the country suspended operations, and for several years it has produced more gold from gold ores than any other camp in Nevada. The camp is supplied with electric power and light over a 73-mile line from Thousand Springs, Idaho, on the Snake River. This district is in northeastern Nevada, in Elko County, near the Idaho State line, in the rugged and scenic Jarbidge Mountains, which here reach an elevation of 11,000 ft. and form a part of the high divide between the Great Basin on the south and Snake River Valley on the north. The nearest railway station is Rogerson, Idaho, 50 miles to the northeast.

The gold is found in quartz-feldspar veins that are contained in rhyolite, an acidic volcanic rock of middle Tertiary age, which is here the country rock and occurs in great extent and thickness. Many of the veins are extensive and some are productive to depths of nearly 1,000 ft.

The district was recently visited by Frank C. Schrader, whose report has just been published as the Geological Survey's Bulletin 741. The report gives an account of the mining developments in the district, describing the mines, prospects, ore deposits, rocks, geography, mining activities, and living conditions, and attempts to forecast its future. It is illustrated by maps, geologic sections, sections of mines, and photographic plates showing the forms of surface relief, the rock structure and weathering, and the microscopic structure of the ores, including the mode occurrence of gold and silver. It includes also a note on the neighboring Charleston district. The report can be obtained from the Director of the Geological Survey at Washington.

Australian Tin Mines Thrive

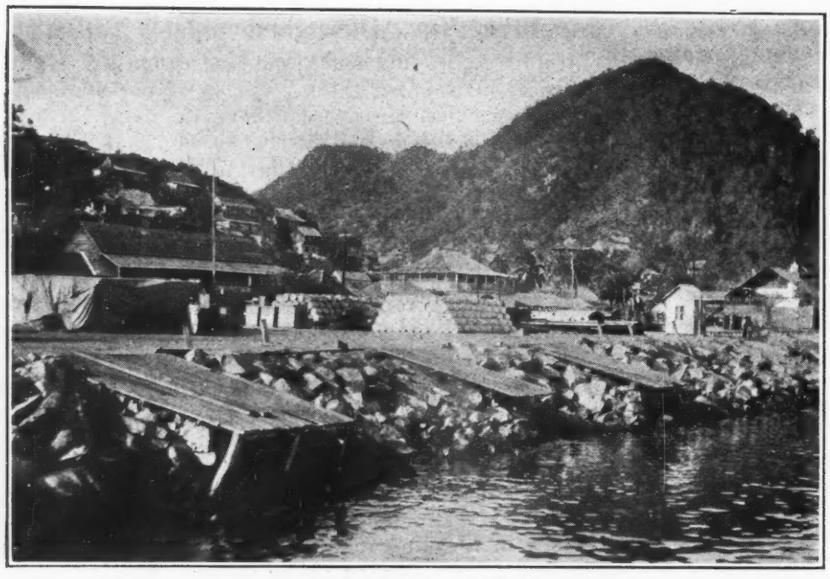
The Sardine tin mine, in the Kangaroo Hills tin field, in Queensland, has paid its fourteenth dividend, making a total distribution of 4s. per share on shares paid up to 3s. 2d. The latest crushing from the mine, consisting of 30 tons, gave a return of six tons of black tin, worth £800. At the Canary, an adjoining mine which is developing ore of a much higher average grade than even the Sardine, a winze from the 82 ft. level has shown 3 ft. of 40 per cent crushing material.

The Port of Manzanillo, Mexico

Offers Certain Facilities to Shippers of Mining Supplies to Points South and West of Guadalajara

By Henry M. Payne

With the increased mining activity in the states of Nayarit, Jalisco, and Colima, in Mexico, attention has been turned of late to Manzanillo as a port of entry for machinery and supplies. The through lines of steamers from Atlantic ports, through the Canal to Los Angeles and San Francisco, all stop at Manzanillo, and there are two other local lines doing coastal business which also serve the port. The sailing time from New York is about eighteen days and from California about six days, including stops, so that the mines west and south of Guadalajara effect a considerable saving in time of delivery by shipping to Manzanillo and thence by the Mexican National Railway lines direct to Colima and Guadalajara, arriving there the second day after clearance. This also facilitates tracing shipments, a process which is calculated to test human endurance when made through the northern gateways, with their several division points and transfers, or from Vera Cruz or Tampico. With the completion of the Southern Pacific link between Tepic and La Quemada, San Francisco shipments will come in via Mazatlan, or all rail. The principal distributing points for the mines in this district are San Marcos, Etzatlan, and Magdalena. The route into the Ixtlan district is shorter from La Quemada and is used for passenger travel, but on account of the Barrancas, pack-mule service is better from San Marcos.



Quai and runways at Manzanillo, where freight is unloaded from lighters. Mining supplies waiting to pass customs

The port of Manzanillo is a squalid tropical town situated on the extremity of a long sandy spit which forms the harbor. To complete the protection from the waves of the Pacific, the government has built a massive breakwater extending out into the harbor for over 600 ft. to a depth of 60 ft. It is constructed of huge granite blocks brought down by rail from the Colima quarries, the outer side being formed of monoliths weighing thirty tons each, and the inner side of blocks weighing up to fifteen tons each, the whole structure being 300 ft. wide at the base and 25 ft. wide on top, with a 16-ft. cement crown. At the extremity is a lighthouse, and along each side of the breakwater are cement seats, the whole forming a promenade offering a possibility of evening breeze in pleasant weather and relief from the typically squalid filth of the town itself. The sanitary situation is aggravated by Alligator Lake, which lies inside the sand spit and is wholly separated from the salt water. During the dry season, this shallow body of water, covering approximately seventy square miles, partially dries up, leaving long shelving sandy approaches with dead fish and stagnant water to send their effluvia over the town except when the situation is somewhat relieved by a sea breeze carrying them inland.

The present government is said to be planning to spend $15,000,000 (Mexican currency) to blast down the hills west of the lake and fill in a portion of it, opening a canal for tidal water to pass back and forth and cleanse the basin. If this were done, and a suitable fresh-water supply piped down from the hills overlooking the harbor, Manzanillo could be one of the best Pacific ports in the republic. At present the water supply for household purposes is brought in in tank cars on the railroad.

The spot is historic, because here in 1525 Cortez built a number of ships to carry on his exploration of the Pacific coast. Mount Colima rises to the northeast. After reaching the mainland by rail, the traveler passes through a tropical panorama of cocoanut, orange, and banana groves, over deep gorges and through many tunnels, emerging on the plateau close to the foot of the volcano, and gradually reaching the cooler llanos of the continental divide.

During the rainy season the port is somewhat congested, owing to lack of modern equipment for moving goods into and out of warehouses. In the dry season the quai forms the principal storage yard, from which the customs examinations are made and transshipment to railroad cars adjoining is effected. Large quantities of cyanide, mining supplies, and foodstuffs may be seen at the head of the runways. The large pier which was burned during a revolution has not been rebuilt, so everything is lightered ashore from the roadstead. The heaviest single piece which can be conveniently handled with the present equipment is six tons. In the case of larger units, the customs brokers will arrange to handle the shipments, but at extra expense.

In addition to purifying Alligator Lake, it is proposed to extend the breakwater from the other shore, to rebuild the pier and to extend the railway tracks out to deep water; also to provide warehouses adjacent to them. Limited hotel facilities already exist, and, with the contemplated improvements to the port, will doubtless be enlarged to accommodate the rapidly increasing travel which the isthmian route service is developing. It is estimated by companies using this route for their supplies that at least two weeks is saved over other routes to mines west of Guadalajara.

William Fleet Robertson, of British Columbia

An Interview, by T. A. Rickard

You are a native of Canada, Mr. Robertson?

Yes, I was born at Montreal in 1859.

What was your early education?

The high-school at Montreal and the Galt Collegiate Institute—Dr. Tassie's school—a boarding-school highly esteemed in those days.

And then?

I entered McGill in 1876, and graduated in 1880.

What notable Canadians now engaged in mining affairs graduated with you?

During my time R. G. McConnell was one of my particular friends in college; later he was Director of the Canadian Geological Survey and Deputy Minister of Mines at Ottawa. Dr. Frank Adams was one year ahead of me; he is now Dean of the Science Faculty at McGill. Philip L. Foster, now living in New York, and long associated with the Exploration Company of London, and A. P. Low, later Director of the Geological Survey, were among my friends at McGill.

At the time you were at McGill did you have any idea of the career you were to select?

Yes, I entered McGill with the particular purpose of going into mining engineering, in which I was influenced by an old mining engineer friend of mine, J. Fraser Torrance.

Who was he?

He was a McGill graduate of 1875 in mining and a resident of Montreal. At that date he was about to proceed to Borneo and I was to accompany him, but he died before I left college. He was the only mining engineer I knew at the time, for mining engineers were extremely scarce in Canada in those days. I was attracted by his description of mining and the chances it offered.

Was your father connected with mining or engineering?

No, he was a lawyer.

You had no atavistic inheritance inclining you to mining?

No, my grandfather was a clergyman.

Evidently we are getting farther and farther from mining, so we will drop that line of enquiry; it must have been your friend Torrance! After graduation at McGill, did you have any trouble in getting a job?

No, I had gone to Sherbrooke, in Quebec, and the then managing director of the Orford Nickel & Copper Co., Major Robert G. Leckie, father of General R. G. E. Leckie and Colonel Jack Leckie of Vancouver, drove me out to see the mine—the Eustis mine at Capelton. That happened during the Christmas holidays before I graduated. I simply told Leckie that I was coming out there after graduation. He said he did not know whether there was a job for me or not, but I said I was coming anyway, and he said, "All right, if you get your degree you can come." So I had my job picked out before I graduated. I entered the service of the company as assistant to Henry M. Howe.

You were fortunate in starting your career with a man of such high character and attainments.

Yes, I was extremely fortunate in having such a man as Howe as my first chief. His endeavor to help me by advice and patience was the greatest thing that could have happened to me. He was of great help to me as a young man in encouraging me to criticize any work that was planned in his office, and to present my own views, receiving with consideration any suggestion, and explaining the whys and wherefores if it could not be accepted.

So you enjoyed your start?

I enjoyed it very much. My first salary after graduation was only $25 a month, but I was able to keep my own saddle-horse and have a pretty good time on my pay.

The company paid your board and lodging?

No, I paid my own board at the company's mess, but lodging was provided.

Evidently $25 went a long way in those days. How long did you remain at Capelton?

About one and a half years: during the construction of the Eustis copper-smelting plant.

Please mention some of the interesting features of your technical operations at Capelton.

The invention of the Raschette furnace; this was the forerunner of modern copper blast-furnaces.

How did it develop?

In 1880 the Orford company, which had purchased a mine at Capelton and was then erecting a smelting plant, had leased the neighboring works owned by a Scotch company that owned the mine adjoining ours. In this plant there were three or four standard blast-furnaces.

What shape had they?

They were square brick furnaces, about 3½ ft. inside, lined with firebrick but without any water-jacket; for this was in the days before the water-jacket had been introduced. The bottom of the furnace was made of a mixture of fireclay and coke tamped tightly. The ore that we smelted was the burned sinter from pyrite after the sulphur had been removed by heap-roasting. The slag and matte flowed into a fore-hearth in which there was a bottom of similar composition. The matte was tapped from the bottom of this basin while the slag flowed forth at an upper level into pots. In the course of operations a 'sow' rich in gold was formed in the bottom of the furnace, by gradual concentration. We wanted to pull down this furnace in order to remove the sow, but, under the terms of our lease, we were not permitted to tear down any furnace—only to repair it—so Howe conceived the idea of connecting two furnaces—four feet apart—by brick walls, in front and back, so as to form one big furnace, 16 ft. long inside, with a width of 3½ ft. The tap-hole was placed three feet lower than the old internal basin. A very fusible and cutting charge—rich in old slag, with additional lime and silica—was fed into this elongated furnace. This soon yielded a melt from the sows in the two former furnaces—through the lower tap-hole. The smelting proceeded so fast that we did not have sufficient slag-pots, because each of the old furnaces had a capacity of 50 tons of charge, whereas the new long furnace began to smelt at the rate of over 200 tons daily.

This must have pleased your directors?

It caused consternation—at first—because we did not

have enough slag-pots, so Howe had a trench dug to run the slag over the dump. The president of the company, W. E. C. Eustis, of Boston, overheard one of the workmen say that he had left some tool "just back of Folly No. 2", which, much to Mr. Eustis' delight, he found to be Howe's elongated furnace; but the tables were turned when we found that the workmen had given the nickname of 'Folly No. 1' to a previous experimental furnace of Mr. Eustis' own design. Those were the early days of copper smelting in America, particularly blast-furnace smelting, and to such men as Eustis, Howe, Leckie, and Robert M. Thompson—the officers of the Orford company—the fact that a thing had not been done was no argument, but only a reason why it should be tried. Many experiments were made, including pyritic smelting and bessemerizing in reverberatories, not all of them successfully, but enough to justify these men being regarded as the pioneers of the present copper-smelting practice of North America.

So you adopted this long furnace as your standard?

In the new works then under construction at Eustis—about a mile from Capelton—we erected furnaces that duplicated 'Howe's folly', and they proved so successful that the type was adopted elsewhere. It became known as the Orford furnace, and is described under that name in Peters' 'Modern Copper Smelting', in Chapter XII, where the dimensions are given as 3 ft. 5 in. by 11 ft. 8 in., these being the internal dimensions of the furnaces erected at Constable Hook. This furnace was the forerunner of the much longer blast-furnaces used at Anaconda. Of course, as you know, the width of such a furnace is limited by the possible penetration of the blast, but the length is a matter simply of convenience. One part of the furnace can be cold while another part is smelting.

Why did you leave Capelton?

I did not leave the company. At that time Howe, for the company, had rented Dr. James Douglas' copper plant at Phœnixville, in Pennsylvania, and the company asked me if I would like to join Howe, continuing as his assistant there. I was only too glad to do so, and served as superintendent of the works under Howe.

To what extent was your salary raised?

I think to about $100. I do not recollect exactly, but I know that I had only about as much left at the end of the month as when my salary was smaller, which was mighty little; but I never went into debt for one cent.

Did your work at Phœnixville last long?

About a year, until Howe went to Constable Hook, in New Jersey, to erect the Orford copper-smelting plant at that place. He took me with him as assistant engineer. I was there for about two years, during the first construction of the plant and its early operations. During this time Edward D. Peters was superintendent and I acted as assistant to him.

I would like to ask you how Dr. Peters impressed you, because I am curious to know whether he was as good a manager as he was an expositor; he was a good writer and an admirable lecturer on copper smelting in later years at Harvard; was he also a good technician?

At that age I was not capable of judging. Peters and I lived together, sharing a sitting-room, and I saw a great deal of him personally, and I had a great liking for him. He was a hard worker and had a profound knowledge of all that had been written on the metallurgy of copper.

You were fortunate in being assistant with such men as Howe and Peters at the outset of your career; it must have been a post-graduate education to work with them.

Yes, it was. Later—the next year—I went to Phœnixville as superintendent of the Douglas copper-smelting plant, at which I had been previously with Howe.

And there you made the acquaintance of Douglas?

An acquaintance that developed later into one of the most valued friendships of my life. I think, even at that age, I appreciated his wonderful personality and open-mindedness, his integrity of purpose, as well as his broadness of mind and erudition on almost every subject. From him I learned to be willing to have all my work an open book for any other engineer to see. He had no use for secrecy.

Did he spend much time at Phœnixville?

Yes, he lived there; his residence was there and his family was living there, so that I saw a good deal of him. His nephew, George Mercer, was our accountant. I mention this because I had the good fortune to marry his sister, and we "lived happily ever after."

When did the happy event take place?

Well, I have a boy of 25—it must have been in 1895, that is, twelve years after the time I am describing.

Was there anything particularly interesting in the technical operations at Phœnixville?

Yes, the Hunt & Douglas process was being tried—experimentally. We were receiving Western mattes and turning them into ingot copper.

I remember that the Hunt & Douglas process loomed large in our metallurgical lectures at the School of Mines, two or three years later than the time you mention, and that it was depicted on a most attractive flow-sheet.

Yes, it was beautiful theoretically, and sound chemically, but most difficult to operate because of the resulting messes—so different from the theoretical anticipation. It never was a process that found general application.

However, it must have given you a good insight into the chemistry of wet copper metallurgy.

Yes, it gave one an insight into the chemistry of it, and also a thorough appreciation of the difficulty of handling wet processes. That is where I learned lead burning; I had to repair my own tanks.

The operations on the whole—the smelting operations—were profitable?

Yes. After finishing my contract—one year—with Douglas I was re-engaged by the Orford company as engineer and assistant-superintendent of works.

Was Peters still there?

No, he was succeeded by John L. Thomson. During my second engagement the smelting of nickel ores was discovered by the company, the preliminary experiments being carried out by Thomas Kiddie, who is now in California, then the chemist of the works, and myself, under the general supervision of John Thomson.

What year was that?

About 1884.

I presume that meanwhile your salary had been increasing, because apparently you had been transferred from Constable Hook to Phœnixville, thus indicating that the company was willing to re-engage you.

Yes, they re-engaged me, but they did not realize that I was no longer the youngster that first came into their works. You have to leave a company to impress

them with that. Which brings me to 1885. In that year the Riel rebellion broke out in the Canadian North-West, and I resigned my position and came to Canada to enlist, but was lucky enough to get a commission in the Sixth Fusiliers, unfortunately not getting any further than a temporary camp at Montreal. I might say for my regiment that no man was eligible unless he was an Orangeman. Sir John A. Macdonald kept that regiment in case of race disturbances in the Province of Quebec.

So how long did this military episode last?

Not leaving for the front, I went to the military college at St. Johns, Quebec, qualifying for my commission there. I was then 25. Then—in the fall of 1885—I was engaged by R. G. Leckie, who had been my first chief, to go to him in Nova Scotia, where he was the managing director of the Springhill collieries, at which place I was engineer and assistant to the managing director, Major Leckie.

The technology of coal was simpler than that of copper, was it not?

In those days in Nova Scotia there was not much technology about coal after it got out of the ground. The mining was comparatively simple, as there we were not much troubled with gas, and the coal measures were fairly regular. I enjoyed the work very much, on account of its variety, from underground surveying of the measures and workings to the superintendence of the railroad to Parsboro, the shipping-point on the Bay of Fundy, and in the meantime running a location line for the proposed railway from the mine to a port on the Gulf of St. Lawrence to the north.

How long did you remain at Springhill?

During the latter part of 1886 I received an offer to proceed to Spain to erect a copper-smelting plant there.

For what company, and where?

The offer came through Fraser & Chalmers, and at first I refused it, but it was repeated, owing to strong recommendations from Dr. Peters and Dr. James Douglas, so I mentioned the offer to Major Leckie, who, while advising me that my work with him had been satisfactory and my position secure, advised me, as I was young, to get the experience in Spain; he said that I could go there, and if I reported by wire within six months that I wished to return my position would be kept open for me. So I went to the Sotiel-Coronada, in the province of Huelva, and only a few miles from Rio Tinto, to erect a smelting plant for a Portuguese company that was buying its equipment from Fraser & Chalmers. The managing director of this company was Don Lorenzo Malheiro, who had been the Portuguese Commissioner at the Centennial Exhibition in Philadelphia.

How long were you in Spain?

A year and a half. I erected a copper-matte plant, consisting of one water-jacket furnace, for smelting the ores previously roasted in heaps in the open air, a 40% copper matte being shipped directly to England. The main trouble was that the roasted ore was nearly clean iron oxide, the ore not carrying more than 4 or 5% of silica, which had to be added in the shape of silicious pebbles picked up from a wide range of territory by girls and boys, and brought into the smelter on the backs of donkeys. There was no other source of silica. I tried a local schist that they had expected me to use as a flux, but it carried so much alumina that it created endless furnace trouble and was rejected. Having completed my work there, I spent a few months in traveling over the northern parts of Africa—Morocco and Algeria—going from there to Bordeaux, with a short stay in Paris, and then back to New York by way of London and Edinburgh. I returned to New York at the close of 1888.

What did you do on your return to New York?

Going to make a call upon the Orford company, I was greeted with the remark: "Just the man we want; when can you start for Michigan?" This happened the day I got home, at which time the Calumet & Hecla was on fire, and the company wanted direct information about it.

This suggests a connection between the Calumet & Hecla and the Orford company; what was it? What was the reason for their interest in the fire?

Business reasons, and the effect of a cessation of production at the Calumet & Hecla on the copper market.

So you went?

So I spent a month or two on the Keweenaw peninsula, which gave me an opportunity to see most of the large copper mines there. I learned that the Tamarack-Osceola company was proposing to erect a copper-refining plant at Dollar Bay. Upon my return to New York, I offered to prepare plans for such a plant for the Tamarack people in competition with any other that might be presented, on condition that if my plans were accepted I should have the construction of the plant and the supervising afterward. My plans were accepted on the recommendation of C. H. Parsons, subsequently managing director for the Boston & Montana Co. After the erection of the plant at Dollar Bay and operating it for about a year, I was offered a position as engineer with Parsons in the construction of the Great Falls copper smelter in Montana; so I turned over the Dollar Bay plant in full operation to Frank Klepetko. That was in 1890.

You accepted the offer?

I did, staying a little over a year at Great Falls. The company allowed me to go to Pennsylvania to see the type of furnace used in steel-making, which I thought could be adopted in copper smelting, as the steel men were distinctly in advance of the copper smelters in the handling of ore in large tonnages. As a result of my visit, the company, at my suggestion, installed a gas-fired tilting reverberatory furnace, practically the same as was used in steel-making. This furnace did good work at Great Falls, although in the end it was superseded by the elongated type of reverberatory furnace. I ran my flues underground to the top of the hill, where I built what was then one of the largest stacks in America, being 24 ft., inside diameter. And I might say that by the side of this stack there has since been erected another chimney about twice the height of mine, making mine look insignificant. In those days the thing was to get the gas out in any way, but nowadays the object is to retard the gas, so as to permit the dust to separate and settle.

Who was the metallurgist at Great Falls?

The Boston & Montana plant was erected on the left bank of the Missouri, just below the Great Falls townsite, where the company built a dam across the river. The plant had not commenced operations when I left. Later, Frank Klepetko, who followed me at Dollar Bay, became the first superintendent of the copper plant, I believe. On the right bank of the river, at the upper falls, a mile farther down, there was a lead smelter, of which H. H. Sticht had charge as metallurgist, with

Dean as superintendent. The latter I found serving as superintendent of the Trail smelter, when I arrived in British Columbia in 1898.

Having completed your work at Great Falls, you moved on, I presume?

Yes, retracing my steps. While there I was induced to go back to the Orford company at Constable Hook, where I made some enlargements to the plant, and later retired from the company's service to go into partnership with Fred. F. Hunt, of New York.

Before leaving the subject of the Orford Copper Company, I would like to ask you if there was anything more in their technical operations that was specially worthy of note?

We were developing the nickel-smelting process invented by the company, and we had the contract for smelting and refining all the matte produced at Sudbury, by the Canadian Copper Company. The Canadian Copper Company was unaware of the existence of nickel in their own ore, and it was the chemist of the Orford company, Thomas Kiddie, who ascertained the fact and then later we discovered a way to treat it. A contract had been all but signed on the basis of only the copper in the matte, but it was not consummated, as the Canadian Copper Co. discovered the nickel in their ore just too soon.

What special process did you apply for the separation of the nickel from the copper?

The smelting of the nickel matte in a blast-furnace with sodium sulphate (nitre-cake), forming a copper-soda matte, with the separation of the nickel as a sulphide at the bottom of the pots. The line of cleavage between the nickel and copper-soda matte was perfect. The first smelting was not complete, and both mattes (copper matte and nickel matte) were again re-treated for purifying. The nickel sulphide was roasted to an oxide, in which condition it was then sold for the purpose of forming a steel alloy, used chiefly for armor-plate in the United States navy. The nickel was made into an oxide because that was the form in which it was most suitable for alloying with steel in the manufacture of armor-plate. The use of nickel in naval construction was due in part to the fact that R. M. Thompson had been a naval officer and appreciated the value of the hardened armor-plate, which it was then discovered could be produced by the aid of this nickel alloy.

So you formed a partnership with Fred. Hunt in New York?

This partnership lasted for three or four years—from 1893 to 1896. We carried on business as consulting engineers, assayers, and chemists at 77 Pine street; our chief clients were the Lewisohns, the Grasselli company, and a Mexican company. The business was fairly satisfactory and my relations with Hunt were most pleasant. We dissolved partnership, and I opened an office in Thames street, where I carried on for a couple of years, retaining my connection with the Mexican company.

But you have not said anything about your partner; what sort of a man was he?

He was an awfully decent fellow, and had been with me previously at Capelton in 1880 and subsequently at various places with the Orford company. Hunt left the company to go to the West, but he returned to New York, where later I joined him.

Meanwhile you had been married?

Yes, in 1895 at Dr. James Douglas' house at Spuyten Duyvil, New York. Douglas was my bride's uncle and practically had been her guardian. After our marriage we settled down on Staten Island, where both of us had been living previously.

So you opened an office of your own on Thames street; with what success?

With very fair success. But our baby boy was delicate and the doctor said that his life depended upon being moved entirely from the vicinity of New York. At that juncture a telegram from the Government of British Columbia arrived asking me if I would consider the position of Provincial Mineralogist for British Columbia, to which I replied asking for two weeks to make a decision, as British Columbia at that time was a *terra incognita* to me. I consulted with Dr. G. M. Dawson, then Director of the Geological Survey of Canada, who told me that as soon as he could retire he intended to spend the remainder of his life at Victoria—which was recommendation enough for me. So I telegraphed my acceptance, and entered the service of the Provincial Government as mineralogist on June 1, 1898, beginning to perform my duties at Golden, because they could not appoint me unless I was a resident of the Province. The next day I left Golden with the then Minister of Mines, Colonel Baker, the brother of Sir Samuel Baker, the explorer, and of General Valentine Baker.

So you have been Provincial Mineralogist for nearly 25 years! You have been able to see the mining industry of the Province grow from almost nothing to something remarkable.

Yes, in the year in which I took charge the total output of the mines was $10,900,000, whereas in 1918 it was nearly $42,000,000.

Your long tenure of office argues political conditions considerably better than those obtaining, for instance, in California, for with us "to the victor belong the spoils".

We have Civil Service, which is at least supposed to be independent of politics, or the spoils system, and which has been pretty well carried out in this Province. My relations with various Ministers of Mines have been pleasant and agreeable—whether mine have been to them it is for them to say. Being able to watch the growth of the industry and individual mines has been most interesting. Any views that I might have formed about any of the mining properties could be tested by watching the development, thus personally correcting or confirming my own estimate to the end.

You consider that British Columbia has still ample scope for exploration and development?

I think one might say so. Whereas our output has not as yet reached a stage comparable with that of some of the States of the American Union, the greatest encouragement has been given by the steady increase of the output from year to year, through many ups and downs. Temporary recessions have been overcome and exceeded by the rise.

Of course, the War and the sudden cessation of the War had a disastrous effect on British Columbian mining?

I would not say "disastrous", but the return of the price of copper to less than pre-war prices, together with an absolute lack of a market, immediately following the Armistice, had its effect, and on top of that we had a diversion of men and money which was incomparably greater than it was in the mining regions on your side of the line. We contributed no less than

10% of our total population to the armies of the Allies.

Including your own son?

Of course! I tried to go, but they turned me down as too old, so my only son Douglas went. He was in uniform at the Royal Military College in 1914, obtaining a commission in the Imperial Royal Engineers in 1916, at the minimum age, and served on the Salonika front first with the Engineers and later with the Royal Flying Corps, until the end of the War, when he returned to the Royal Engineers and was sent to India, where he has served for the past three years, until he was sent this autumn to Cambridge for a special course. It was the same in every family, the young men were moved from the working to the firing line, and lucky are we whose boys came out unscathed.

Soluble Silica in the Preparation of Zinc Sulphate Solution for Electrolysis

BY J. O. BETTERTON*

Recently some experimental work was conducted on the direct leaching of zinc ores with sulphuric acid, and the subsequent precipitation of the zinc by electrolysis. The ore contained relatively large quantities of soluble silica; also vanadium, the recovery of which was desirable. The experimental plant produced 50 lb. of zinc daily for a year.

The 40-mesh ore was leached directly with spent electrolyte containing 3 per cent zinc and 10 per cent free acid. The resulting acid leach solution was treated for the removal of vanadium; then the silica and vanadium were precipitated and removed by a filter press. The filtrate was treated with zinc dust before going to the cells for electrolysis. Thus the following products were to be considered: Ore, ore residue, acid leach solution, silica residue, silica filtrate, zinc dust purification residue, and final solution.

Considerable trouble was caused at first by the gelled condition of the slightly acid silicate solution used for leaching. The effects of temperature, carbon dioxide, air, and oxidizing compounds in the spent electrolyte were found to be slight or nil. The effect of zinc concentration, or the effect of a strong electrolyte, was most marked. It was demonstrated that an extremely regular relation exists between the zinc concentration and the time of gelling—the higher the zinc the sooner the gelling. Also, the higher the free acid the quicker the gelling. Furthermore, the time interval preceding incipient gelling is shortened as the silica is increased from 8 to 10 grams of silica per liter. The curve then reverses and the time interval rapidly increases as the silica increases from 10 to 13 grams per liter. These results were obtained on a laboratory scale, but the indications were that they would also be obtained in a large plant.

Following many experiments, a method of removing the silica from solution in filterable and washable form, or in the so-called granular condition, was developed. In the early work the faintly acid solutions were treated with milk of lime, but this required large quantities of lime, and it became evident that the effective result was to precipitate the silica by making the solution alkaline. Zinc oxide fume was then used to bring about the desired alkalinity. Using zinc oxide, the silica is precipitated in less than one hour when the solution is heated to a temperature of 90 to 100 deg. C., 5 lb. in excess of zinc oxide being added to two tons of solution containing 1 per cent silica and 5 to 6 per cent zinc. The silica is not entirely removed from solution under these conditions, 1 or 2 per cent of the total silica coming down later in the zinc-dust purification. The silica separates rapidly from the first, but until precipitation is practically complete the clear supernatant solution refuses to pass through a filter paper. The precipitated silica filters and washes readily after the reaction is ended, it being the silica in solution in the transition stage that causes trouble.

*Abstract of paper No. 1197-M, prepared for the New York Meeting of the A. I. M. E.

Advantages of Chile Copper Company's New Copper-Silicon Anodes

A writer in *Chemical & Metallurgical Engineering* calls attention to the new copper-silicon alloy used as an anode in the electrolytic tanks of the Chile Copper Co. at Chuquicamata. From the standpoint of technology, he says, the most interesting and important portion of the annual report of the Anaconda Copper Mining Co. is the following statement referring to electro-metallurgical practice at Chuquicamata: "The solution is electrolyzed with a special copper-silicon anode which has greatly reduced the cost."

At this plant the solution for electrolysis is formed by leaching oxide ores containing about 1.8 per cent copper with dilute sulphuric acid. In the electrodeposition of copper from such copper sulphate electrolytes, ferrosilicon anodes (about 87 per cent iron and 13 per cent silicon) have been largely employed in commercial practice. Lead has also been used. The copper-silicon anodes referred to contain 15 to 25 per cent Si, 2 to 15 per cent Mn, 0.5 to 10 per cent Pb, 0.01 to 10 per cent Ba or Ca, with the remainder Cu.[1] These have the advantage over ferrosilicon anodes in that a normally lower voltage can be used and substantially no iron is introduced into the electrolyte by corrosion of the anode, whereas with ferrosilicon anodes a considerable contamination of the electrolyte by introduction of iron takes place, and this increases progressively with recirculation of the electrolyte.

By avoiding such introduction of iron, the copper-silicon anode materially decreases the cost of maintaining a low iron content in the electrolyte, as the electrolyte can be used for longer periods without requiring purification, thus reducing the acid lost with impure electrolyte and reducing the amount of impure copper formed. Compared with the use of a lead anode, the copper-silicon anode presents the advantage of increased efficiency, particularly in electrolytes containing iron, inasmuch as lead anodes give extremely low current efficiency with such electrolytes unless special precautions are taken to keep the iron in the ferrous condition. The anode loss is materially less than with either ferrosilicon or lead anodes, with certain electrolytes, particularly copper sulphate electrolytes containing chlorides and nitrate. Owing to the relatively low first cost of the anodes themselves, and their resistance to breakage during handling and ordinary use, as well as their resistance to anodic disintegration, the process can be carried out for long periods of time, with resulting low cost of operation for the anodes, as well as with economy of operation in low voltage and power consumption and high current efficiency.

[1]See U. S. Patents 1,441,567 and 1,441,568, issued Jan. 9, 1923, to Colin G. Fink, assignor to Chile Exploration Co.

West Shining Tree Gold Prospects

Geology of This Northern Ontario District—Results of Development Warrant Further Work

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THE PHENOMENALLY RICH specimens of gold ore found in 1911 in the West Shining Tree region of Ontario led to extensive prospecting, largely by trenching in the mantle of glacial gravel and clays which, with muskeg and moss, cover a large part of the area. The four townships composing the district, all in the Temogami Forest reserve and about 40 miles south of the Hollinger and Dome mines, were formerly thickly timbered, but forest fires have changed the evergreens to bare poles, or a tangled mass of partly burned logs. These fires, deplorable as they were, have, however, facilitated prospecting.

General Geology of the Area

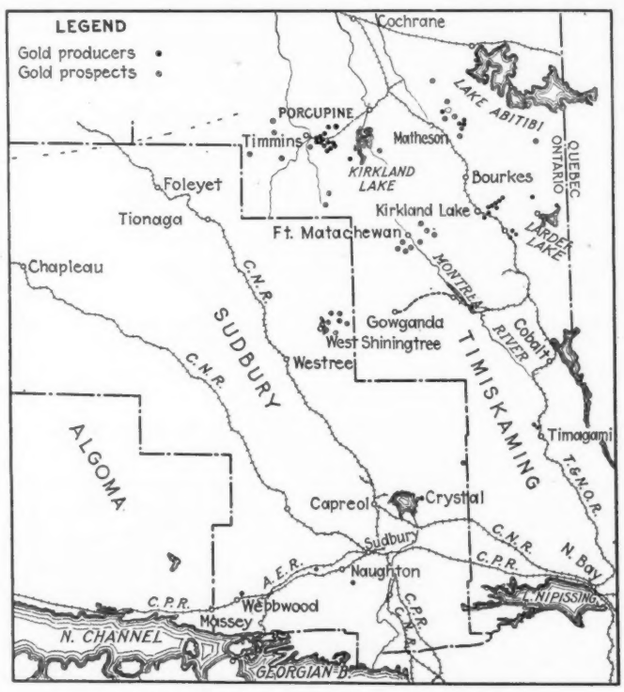
The broader geologic features of the Shining Tree district are favorable for the occurrence of gold deposits, the work of both the Dominion Geological Survey and the Ontario Bureau of Mines showing that it borders an extensive area of granitic rock and that the gold deposits thus far found are in the schistose rocks that lie along the eastern margin of the batholith. So far as known, there are no ore deposits in the zone of intense contact metamorphic alteration, nearly a mile wide, which borders the granite in the southern part of the Shining Tree area. The numerous gold deposits are in the less altered schistose rocks farther away from the margin of the granite area. The schist area contains many different rock types, mainly igneous with andesitic varieties predominating, but also containing ultra basic and siliceous rocks. Though this mass, which as a unit is most conveniently referred to as a schist-complex, consists mainly of igneous rocks, it also contains interbedded sediments. This complex is cut by intrusive bodies of a dark-colored dense "mica trap," or lamprophyre, whose association with gold ores is supposed by some observers to be a genetic one. Dikes and irregular intrusive bodies of a pale rhyolitic rock, an old quartz porphyry, also occur. All these rocks are pre-Cambrian, being mainly of Keewatin age, but containing some that are regarded as of Temiskamian age. All the rocks of this complex are intruded and cut by great masses and dikes of granodiorite and of quartz porphyry of later age, all considered to be parts or offshoots of one great granitic mass.

Similarity to Porcupine and Kirkland Lake

The occurrence of the gold veins along the border of the great granite area is quite marked, presenting the same association of gold-quartz veins and igneous intrusions as is observed in the Porcupine and Kirkland Lake district. This similarity of occurrence, and the mineralogic features of the deposits, I regard as a sufficiently favorable condition to warrant careful investigation, and extensive development work on the best gold showings.

The gold-quartz veins cut through all the rocks mentioned above, save the granite, and all the known veins appear to be clustered in two main areas, one in the vicinity of Shining Tree Lake, and the other, which includes all those on which any considerable amount of development had been done, along the shores of Michiwaganda Lake. At both places the gold veins may be grouped in two series, according to their strike or direction. In one series, the veins run nearly east and west, their course conforming with that of the schists. These veins are characteristically narrow, lenticular in structure, and contain rather short but often very rich bunches of high-grade gold ore.

The other and more important series comprises relatively few veins, but these cut across the schists at almost right angles, are persistent for long distances, often for several miles, and are wider and somewhat



Gold districts of northern Ontario

less bunchy than the east-west veins. So far as shown by existing development, such veins carry ore over greater widths and for longer distances than the veins running with the schistosity.

The normal ores in all the veins of the district are of the common gold-quartz type. The quartz is white to translucent, is fractured, contains abundant pyrite, fine gold, and at times small nests of coarse free gold. Tellurides occur rarely, and occasionally galena, zinc blende, and sometimes chalcopyrite also occur. The gangue is quartz, with accessory chlorite, and occasional ankerite, and it often contains enclosures of altered wall rock. Tourmaline, chlorite and mariposite also occur in the quartz gangue and suggest a comparison with the gold ores of California.

Extensive sampling shows widespread auriferous mineralization throughout the district. This and the occurrence of payable values for considerable lengths

along the exposed portion of several veins—e.g., on the Wasapika (or Ribble-Miller-Adair-Foisey), Herrick, Buckingham, and Churchill properties—warrant the expectation that such ores may occur in commercial amount and certainly indicate that the properties deserve further development to prove the extent of the orebodies and block out reserves sufficient to justify the erection of milling plants.

At present the lateral development underground by drifting along the veins is too limited to furnish positive proof that the oreshoots thus far discovered, or those indicated by surface work, actually persist to any considerable depth. However, a detailed study of several mines indicates that further underground development will disclose average values as good as those found at the surface. The work thus far done apparently warrants the belief that the surface conditions are a fair index to the length and width of the oreshoots, and that the surface distribution of the gold is a fair indication of what may reasonably be expected underground.

It is probable that the limited amount of development throughout the camp is in part due to the fact that it was easier for the former owners and share vendors to make money from the sale of shares than to make it out of the mine. Until recently the properties have therefore derived comparatively little development from the proceeds of stock sales. Moreover, the conditions brought about by the World War made gold mining temporarily unattractive. Several of the properties show surface conditions that fully warrant carefully planned systematic development to prove whether they do or do not contain orebodies of sufficient size and richness to make mines. While very rich ores have been found thus far in only limited amounts, the average content in the oreshoots now known will make profitable ore if a sufficient tonnage can be developed by underground work.

The observed facts may be summarized as follows:

The district contains numerous gold-bearing veins in schistose rocks near igneous contacts, scattered over an area of four townships.

The east-west veins are numerous, are prevailingly small, averaging perhaps 2 ft. thick, and contain extremely rich ore. This, however, is in small amount and irregularly distributed. Local expansions of the veins seen on the Churchill and Atlas properties may make oreshoots of workable size and value and thus form the basis of profitable mining operations.

The underground development thus far done throughout the district is at relatively shallow depth, exploratory shafts being only 200 ft. deep at the Ribble mine, 165 ft. at the White Rock, 105 ft. at the West Tree, 90 ft. at the Buckingham, 257 ft. at the Herrick, 100 ft. at the Steep, and but 50 ft. at the Holding and Kingston mines. This exploratory work has, however, shown that the mineralization continues downward unchanged in character and indicates that the gold is not merely a surface enrichment, but gives promise of extension downward to considerable depth.

The unproven factor in the district is whether or not the quartz deposits and veins contain payable values in commercial quantity. The conditions disclosed by the limited development work on the Wasapika, White Rock, Herrick, Buckingham, and Holding properties, though favorable, do not justify the expression of a positive opinion.

The larger masses of gold quartz, such as those of the Miller-Adair, on the Wasapika vein, it is true, do give promise of a considerable tonnage of milling ore, comparable perhaps to some of the mines of the Kirkland Lake district. There are possibilities of making large tonnages at vein intersections. At the Wasapika mine, ore is said to be proven for over 800 ft. along the vein and for a depth of 200 ft. and a width in places of 23 ft. Both these properties have good oreshoots, but need further development to prove whether or not they will make big mines. The Buckingham and Churchill properties also show consistent gold values over the length of the quartz thus far exposed; these veins, when developed, may supply ore enough to warrant the erection of a mill.

Gold is found in nearly all the prospects, though in most of the veins it was irregularly distributed and the quartz between the pockets of high-grade ore is too low-grade to mine. Compared with those in the Porcupine district, which they resemble in many ways, the Shining Tree veins, with several important exceptions, are smaller, and their mineralization is fully as "bunchy." Development work, however, is fully warranted, as experience at both Porcupine and Kirkland Lake has shown that the ore found at a depth of 500 ft. or more is as good as if not better than that seen at the surface.

Experience in the various gold camps of Ontario has proved that surface sampling alone, no matter how thorough, does not determine the value of a property, and it is quite as misleading to rely upon such work as the essential factor in a diagnosis as it is to base an opinion upon the prospector's firm belief in an increase of value with depth. On the other hand, in this intensely glaciated region of ancient and upturned rocks, work at a moderate depth below the surface usually reveals conditions that may safely be assumed as normal. These, when properly interpreted, may be used as a safe basis for prospecting, though not for actual valuation.

The surprisingly favorable results of deep development in the big mines of the Porcupine district suggest the desirability of deep exploration work at such of the Shining Tree properties as show satisfactory geologic conditions.

The Greatest Lead-Silver District in the United States

The Coeur d'Alene district, in northern Idaho, is by far the most productive source of lead-silver ores in the United States, the total value of the metals produced there during the last ten years having ranged from $20,000,000 to over $50,000,000 annually. Besides lead and silver, considerable zinc and copper and some gold are produced.

The district was described by the Geological Survey in a comprehensive report issued in 1908. A later report, entitled "Geology and Ore Deposits of Shoshone County, Idaho," by J. B. Umpleby and E. L. Jones, issued as Bulletin 732 of the Geological Survey, not only brings the older report approximately up to date but describes also other mining districts in Shoshone County. The authors of the bulletin show that, despite the large output of the Coeur d'Alene district since 1908, the discovery of new orebodies has more than kept pace with the exhaustion of old ones, and it will probably be several years before production begins to decline, as it inevitably must.

THE PETROLEUM INDUSTRY

New Producing Areas in Texas

First Flowing Well in Panhandle Completed—Old Fields Extended—Important Holes Completed on Gulf Coast

OIL has been discovered in several new areas in Texas in the last few weeks. The Hardeman well of the Caldwell Oil Co., five miles northwest of Luling, Caldwell County, came in flowing about 1,000 bbl. a day. A little later, the Royal Oil Co.'s No. 1 Tabor well, one and one-half miles from the Caldwell discovery, was brought in at 2,130 ft., flowing 1,500 bbl. from the Edwards lime. A new producing area has been opened in northern Archer County, five miles east of Holliday. Here the Mid-Texas Oil & Gas Co. struck oil at 1,603 ft. in a wildcat well on block 4, S.P. Ry. Surv. A-1044. Another wildcat well, drilled on State University land, southwestern Regan County, by the Texon Land & Oil Co., came in flowing 100 bbl. of 38-deg. Bé. oil from 3,055 ft., it is reported. This well is 175 miles from the nearest pipe line in Central West Texas. The Oil Lease Development Co. has struck a flow of gas at 1,085 ft. in its Indio Ranch test. A lease of 160,000 acres is owned in Maverick and Dimmit counties. The company is controlled jointly by the Middle States Oil Co. and the Southern States Oil Co. The first flowing well in the Panhandle was completed in Hutchinson County June 4, by J. C. Whittington. It is reported that the well made an initial flow of 320 bbl. of 38-deg. Bé. oil from 3,077 ft. in 20 hours.

In addition to these discoveries in new territory, several important extensions to old fields have been made. The proved area of the Currie field has been extended one mile west by the completion of the J. K. Hughes Development Co.'s No. 1 J. N. Morrow well, making an initial production of several thousand barrels of 42-deg. Bé. oil from 2,181 ft. In the Pioneer field the Texas Company has brought in its No. 1 W. J. Morgan well making 3,150 bbl. from the regular Pioneer sand at 2,450 ft. This well extends the field one mile to the northwest. The Powell field, in Navarro County, has been extended west of Chambers Creek.

In the Gulf Coastal region important completions have been made in the Blue Ridge and High Island dome fields. At Blue Ridge, Fort Bend County, the Texas Company completed its No. 10 Robinson on June 15, making 3,000 bbl. from 3,885 ft. The well is on the northwest side of the dome, and affords much encouragement for further development. At High Island, Galveston County, The Sun Co. No. 1 B. & O. well came in heading 1,000 bbl. of 22-deg. Bé. oil from 2,177 ft., making the first gusher on this dome. High Island has been long known to be a salt dome, but began producing only recently. The most active field on the coast is Orange, Orange County, where several good wells have been completed recently. West Columbia, Goose Creek and Hull alternate week by week in taking first place in production among the coastal fields.

California Petroleum Situation

Opinions of the oil producers throughout southern California vary somewhat as to the period in which the peak of production will be reached, according to the *Mining and Oil Bulletin*, issued by the Los Angeles Chamber of Mines and Oil. A comparative analysis made by representatives of the *Bulletin* indicates the consensus of opinion to be that the peak of production for southern California fields will arrive in September.

It is possible that the Huntington Beach field may have passed its peak late in August or early in September.

If the deeper sands in the Long Beach field are not as highly productive as now seems possible, or their area is not as great as might be expected, this field may have passed its peak in August. If these deeper sands are as good, or better, than now seems possible, it will be late in September before the Long Beach field will reach its maximum.

There seems to be no question in the minds of producers that the potential production of Santa Fe Springs is the greatest of the three fields. Only care exercised by producers in handling the present situation will determine the exact time when the peak of production in this field will be reached.

There was in storage in California on May 31, 69,480,405 bbl. of oil. A compilation of statistics available from several sources indicates that there was available on June 30 or under construction approximately 39,000,000 bbl. of storage space. This includes the empty storage in the San Joaquin Valley, which could be made available by transporting oil to San Francisco Bay and pumping it back to the Valley reservoirs. If available storage is not filled at a greater rate than now seems practicable, and if the producers keep their heads and do not get panicky, it seems that the peak of production may be passed without a further cut.

Control of Hudson's Bay Co. to Remain British

British stockholders of the Hudson's Bay Co. have frustrated alleged efforts of American interests to get control of the company by adopting a resolution prohibiting foreign corporations or corporations under foreign control from owning more than a quarter of the total capital stock. These American capitalists are said to be much interested in the great holdings of the company in Canada, extending into the Arctic, which are believed to contain great quantities of petroleum. Speculation as to the reason for the step taken by the company is to the effect that the move made was merely one of reprisal or was else made to maintain British domination in the company's affairs. The recent act of the Union Oil Co. of California in organizing a financial trust so as to keep the company's affairs in the hands of Californians is pointed out as a parallel case and as a possible incentive.

SOCIETIES, ADDRESSES, AND REPORTS

Regulation of Coal Industry Recommended

Fact Finding Commission Issues Anthracite Report—Says President Should Have Power to Take Mines in Case of National Emergency

THE anthracite report of the President's Coal Commission, which was made public July 9, is an honest and courageous document. It is destined, many believe, to exert a powerful influence on the entire coal industry. Its twenty-one recommendations indicate that the industry's ills have been diagnosed skillfully. There will be differences of opinion as to the benefits which would follow the application of the remedies proposed, but it must be admitted that the report suggests no resort to paternalism and places main responsibility on the persons in the industry to conduct it so that imperative public interests will be reasonably served. The outstanding recommendations of the report are: Government regulation of the anthracite industry and full authority for the President to take over the mines, transportation, distribution and marketing of the product in the event of strikes or suspension of operations.

The representative character of the commission is expected to insure the serious consideration of its findings by Congress, by the industry and by the public. The case of coal has been laid before a jury of six Americans. The jury forms a splendid cross-section of conservative thought in the country. They cannot be accused of being demagogues or cowards. No one could have brought pressure to bear on them successfully. The report that the Attorney General had inflicted some of his ideas on the commission was unfounded.

The jury of six Americans molded its own report. One of the chief points of significance about the report is the fact that it represents the sober, carefully weighed conclusions of men who are so representative of the American people and who have had at their disposal the most complete basic data to guide them. The conclusions that have been reached by a millionaire mining engineer, a Jeffersonian Democrat, the editor of the *Atlanta Constitution*, a Down-East Yankee, a lecturer and economist reputed to be hostile to corporate interests and a man who has steered a middle course between employer and employee for twenty years will not be greatly different from the conclusions which would be reached by the majority of American citizens if they had the same well-rounded understanding of the subject.

The anthracite situation has been analyzed without bitterness. There is a flavor of tolerance throughout the document. It creates an impression of sympathetic understanding, but it expresses firmly the belief that the public has a right to be insured service by the coal industry. It is made plain that the commission does not want that service on any terms which will not give fair profits to the owners and wages to the workers in keeping with the American standards of living. It does indicate, however, that the public is in a mood to insist on a steady supply of coal.

The commission plainly conceives the anthracite business as being affected by the public interest and impressed with the public use—phrases used several times in the report. One of the most significant statements in the whole report is this one: "Coal is quite as much a public necessity as gas, street railway service or any other service or commodity that has been brought under public regulation. The commission admits that there is not sufficient basis in knowledge or experience as to just how far control or regulation should be exercised in insuring maximum service to the public by the coal industry. But it calls upon the public to take a healthy interest in looking out for its own welfare. The commission does recognize that any failure on the part of the industry to discharge properly its own responsibilities, thereby stopping the flow of coal long enough to imperil the public interest, would justify the government in taking over "the operation of the mines and the transportation and distribution and marketing of the product with full power to determine the wages to be paid the mine workers, the prices at which the coal shall be sold and subject to court review, the compensation to be paid to land and mine owners."

It was not more than a month ago that the Supreme Court of the United States, in the Kansas Industrial Court case, said that since the adoption of our Constitution the vocations of the coal miner and the coal operator have not been regarded as public callings. The utterance of the Court is a historical fact, but this jury of six representative Americans has decreed something different for the future.

Status of Licensing in New York Announced by Mathewson

E. P. Mathewson, chairman of the committee for the repeal of the engineers' licensing laws in the State of New York which was appointed by the New York Section of the A.I.M.E., has reported the following developments to the committee:

1. An amendment to the original licensing law has been passed postponing the date on which it is mandatory for an engineer to take out a license from May 5, 1923, to Aug. 1, 1923. This is Chapter 330 of the Laws of New York, 1923, amending Section 37 of the Engineers' Licensing Law.

2. A further very important amendment has recently been passed by both houses and signed by the Governor. This exempts all persons employed solely as officers or employees of a corporation engaged in interstate commerce. This is the Kavanaugh Senate Bill, No. 2237, amending Section 39-K of the existing law.

3. A bill repealing the Pennsylvania Engineers' Licensing Law passed the House by a large majority and was up for the third reading in the Senate.

Milwaukee Next Meeting Place of Mining Congress

Announcement that the twenty-sixth annual convention of the American Mining Congress will be held at Milwaukee, Wis., Sept. 24-29 next has been made. Headquarters will be at the Wisconsin Hotel. Important sessions of the convention will be devoted to the following topics: Industrial co-operation; selective immigration; taxation; standardization; conservation; gold and silver; and oil shale.

The National Exposition of Mines and Mine Equipment will again be an important feature of the convention. It will held in the Public Auditorium and will occupy 45,000 sq.ft. of floor space. Provision for reduced railroad fares on the return trip has been made. E. C. Porter is the convention manager.

Alabama Survey to Publish History

To mark the completion of fifty years' existence of the Geological Survey of Alabama, a history of geological work in the state from the earliest times to the present is being prepared. It will probably be accompained by a sketch of the stratigraphy and mineral resources of the state, to take the place of some earlier publications that are now out of print or out of date.

MEN YOU SHOULD KNOW ABOUT

Dr. Kuno B. Heberlein has left for Europe on business.

C. M. Weld, of Weld & Liddell, is in West Virginia on professional business.

Jerome A. Hilbert has been appointed manager of the Dolores y Anexas Mines in Mexico.

A. E. Brugger, mining engineer, sailed from New York recently for the Belgian Congo.

Fred A. Jordan has resigned as general superintendent of the Mesabi Iron Co., at Babbitt, Minn.

O. W. Jones, president of the Rochester Silver Corporation, has been in Reno from Chicago on company business.

Jerome Drumheller, president of the Fern Gold Mining Co., of Willow Creek, Alaska, has left for a visit of inspection to the property.

Clifford R. Wilfley has left Ouray, Colo., and has gone to Bonanza, in the same state, to enter the employ of the Colorado Corporation.

E. F. Burchard is doing geological work on the bauxite deposits near Louisville, Miss., for the U. S. Geological Survey.

Leopold Albu, of Albu Bros., London, England, who are interested in South African mines, has returned from a visit to the Porcupine mining area.

C. E. Waldner, chief engineer for the West End Consolidated Mining Co. at Tonopah for several years, has resigned his position and moved to California.

Dr. Leopold Reinecke, a former member of the Canadian Geological Survey, is now practicing as a consulting geologist in Johannesburg, South Africa.

J. M. Hill, of the U. S. Geological Survey, has returned to San Francisco from Randsburg, Calif., where he spent two weeks in studying recent developments.

Prof. H. Louis has been appointed a member of the British commission on subsidence caused by mining operations, of which the Viscount Chelmsford is chairman.

George Huntington Clarke, of the Alabama Geological Survey, is investigating bituminous or asphaltic rocks, bauxites, fuller's earth, and clays of Alabama.

George A. Packard, of Boston, was in New York last week on his way to Arizona and Old Mexico, where he will spend the next few weeks examining mining properties.

A. W. Newberry, mining engineer, has returned to New York after a two months' absence in the West and is planning to sail for Africa on Aug. 9 to be gone ten months.

Captain Charles F. Williams, chief engineer for the National Metallurgical Co. in San Luis Potosi, Mexico, is at the Reserve Officer's Training Camp, Fort Sam Houston, Tex.

L. A. Levensaler, of Seattle, who is now manager of the Kelly Mines Co., of the Willow Creek district, Alaska, recently arrived at the mine to direct additional development work.

Dr. Charles P. Berkey and **Dr. R. J. Colony,** of the New York State Geological Survey, are this season studying the complicated geological problems of the Schunnemunk Mountain region.

E. W. Mitchell, president of the New Dominion Copper Co., who resides in New York, is visiting the company's property near Globe, Ariz., with a party of eastern business men.

Senator Warren, of Wyoming, with a Congressional party, has just completed a two weeks' visit to Alaska. The trip was largely for the purpose of obtaining first-hand knowledge of the mining activities of the Territory.

E. S. Leaver, formerly superintendent of the U. S. Bureau of Mines Southwest Experiment Station, at Tucson, Ariz., was selected to succeed Dr. Lind as superintendent of the Rare and Precious Metals Station at Reno.

Stanley R. Moore, mining engineer of Wallace, Idaho, has gone to Broad Pass and Fairbanks, Alaska, where he will remain for at least three months investigating mining property for a syndicate of Wallace and Spokane mining men.

R. H. Kudlich has finished his assignment to investigative work with the United States Coal Commission and has returned to the position of assistant to the Chief Mechanical Engineer in the Washington Office of the U. S. Bureau of Mines.

Noel Hubbard, formerly principal clerk of the Mississippi Valley Experiment Station of the U. S. Bureau of Mines at Rolla, Mo., has resigned to accept the position of assistant registrar of the Missouri School of Mines and Metallurgy.

J. Harvey Whiteman, has resigned as president of the Tonopah Mining Co., because of ill health, and has been elected chairman of the board, a new office. **Charles R. Miller,** has been elected president and **Walter L. Haehnlen** vice-president to succeed Mr. Miller.

William Kelly, for the last thirty-two years manager of the Penn Iron Mining Co. mines at Norway and Vulcan, Mich., has resigned and is to be succeeded by **David B. Cavan,** who has been superintendent of one of the Pickands, Mather properties on the Mesabi Range.

Dr. D. B. Dowling, of the Canadian Geological Survey, will investigate artesian well possibilities in a dry area near Peace River, Alta., this summer, will look into reported discoveries of placer gold and platinum in the Red Deer district and examine the petroleum areas of southern Alberta.

Frank Probert, dean of the mining department at the University of California, is accompanying **J. T. Crabbs** and **H. S. Munroe,** president of and manager for the Granby company respectively, on a tour of inspection of the company's properties. They have visited Copper Mountain, Cassidy colliery, on Vancouver Island; Anyox, and now are in the Salmon River district.

D. G. Kerr, McGilvray Shiras, and **Homer D. Williams,** Pittsburgh officials of the U. S. Steel Corporation, and **W. J. Olcott, Pentecost Mitchell, J. H. McLean, J. H. Hearding,** of Duluth, Minn., and **O. C. Davidson,** of Iron Mountain, Mich., officials of the Oliver Iron Mining Co., have just completed a tour of the Steel Corporation mines on the Michigan Ranges.

OBITUARY

Samuel Franklin Parrish died in Los Angeles recently. He was born in Philadelphia, Oct. 5, 1853.

William Glover, of Nelson, B. C., eighty-five years old, one of the pioneers of the Cariboo district, in which he was active in its earliest history, died in Nelson on June 5.

William Maynard Hutchings

A. Short, of Wellington Quay-on-Tyne, England, has sent to the *Journal-Press* the following appreciation of William Maynard Hutchings, who died early this year:

"William Maynard Hutchings, who died at Harrogate, England, on Jan. 17 last, at the age of seventy-three, was identified for the greater part of his life with the English lead industry and particularly as he played a large part in the development of the Parkes desilvering process. He was born at Sheffield in 1849. Part of his schooldays were spent in England and part at a Moravian School at Neuwied on the Rhine. After a year or two under a private tutor he received technical training at Freiberg Mining School and Leipzig University. At the Freiberg Mining School he took the full mining and metallurgical course. Leaving Freiberg, he continued his studies at Leipzig University, after which he opened an assay office in Liverpool. Later he took up an active part in metallurgical work in widely varying fields.

"In connection with the smelting of lead ores, Mr. Hutchings played a large part in the development of blast roasting. He also introduced many improvements in the methods of smelting and refining antimony, and for many years he devoted attention to petrological work. His early work in this field was on the altered igneous rocks of Cornwall. Mr. Hutchings was the author of various papers on geologic subjects and in 1902 he was awarded the Barlow-Jameson Fund of the Geological Society."

THE MINING NEWS

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Leading Events

RUMORS persist in financial circles to the effect that a third large copper merger, to include various producers in the Southwest and perhaps Calumet & Hecla, is nearing consumation.

Goldfield, Nev., is burned to the ground; nothing remains but six stone buildings.

Russian Soviet Government appears to be making concessions that will enlist private capital in mine development.

Plans are pending for the erecting of two new zinc smelters at Amarillo, Tex., where fuel gas is available.

The South Lorrain (Ontario) silver district is the scene of vigorous prospecting and development.

The starting of the first section of New Cornelia's flotation plant at Ajo, Ariz., is set for October.

Senator Pittman believes he has evidence of misrepresentation by Treasury officials. He has asked for a resubmission of the silver question to the Comptroller General.

The Granby Consolidated has suspended operations at its recently acquired Copper Mountain property.

Cripple Creek (Colo.) prospects improve; lessees are given more generous terms.

The Utah Copper Co. is building eighty-eight new brick dwelling houses at its mines and mills.

The Tom Reed Mining Co. may arrange to finance the construction of a mill for the Katherine gold mine near Oatman, Ariz.

Reorganization of the Cia. Metalurgica Mexicana, involving the A. S. & R. Co., has been approved.

Third Copper Merger Being Considered

Rumors Involve Nearly All Southwest Producers—Calumet & Hecla Also Mentioned—Plans Still Uncertain

RUMORS continue to circulate in the financial districts to the effect that plans for merging at least six or eight of the large copper producers in Arizona and New Mexico are progressing. Calumet & Hecla also is mentioned. Authorities go so far as to say that the proposal has been accepted "in principle." The apparent end in view is to form a third large unit similar to that composed of Anaconda and Chile, and Kennecott and Utah Copper. It seems strange, however, that Inspiration, which is controlled by Anaconda, and Nevada Consolidated, of whose stock Utah Copper owns a major portion, are both named as possible units in the proposed merger. The other companies include Calumet & Arizona, Chino, Greene-Cananea, Magma, New Cornelia, Phelps Dodge, and Ray.

In some quarters it is held that if Phelps Dodge and Greene-Cananea should be included, Calumet & Hecla would stay out, or, on the other hand, Calumet & Hecla might join and the other two would remain out. The reason ascribed for this is to avoid the formation of an organization that would control too large a proportion of the American output.

If the producers in both North and South America should be thus combined in three dominant groups, it is believed that the market for the metal would be steadied. Output could be more easily synchronized with consumption. Leaders in the industry declare that there is no intention of trying to monopolize the industry but rather to co-ordinate output and marketing. It is argued that uniform and steady operation will result in ultimate benefit to the producer, fabricator, consumer, stockholder, and employee. Shutdowns and periods of depression operate to the disadvantage of all concerned.

Whether the merger will be accomplished by an interchange of shares or whether one company will be selected as a nucleus to absorb the others remains to be determined. The entire matter is apparently still in the air, but those who are well informed believe that before the year is out some important merger will be effected.

Iron-Ore Shipments Totaled 16,185,482 Tons to July 1

The freighters on the Great Lakes moved 9,499,500 tons of iron ore from mines in the Lake Superior district during June, and the total for the season to July 1, in spite of a late opening of navigation, was 16,185,482 tons. Early prodictions were that 60,000,000 tons would be moved from the district this year, but it is now estimated that the total will not be in excess of 55,000,000 tons.

Tom Reed May Finance Katherine Mine, at Oatman, Ariz.

It is reported that negotiations are under way that may result in the Tom Reed Gold Mining Co., of Oatman, Ariz., obtaining an interest in the Katherine mine, on which rich ore has been found during recent years. The Katherine is in the Oatman-Kingman district. It is expected that the Tom Reed will finance the Katherine and build a 150-ton mill at the mine. If the proposals should meet the approval of the Katherine stockholders, the deal will likely be completed by September.

Martin Insull Inspects Promising Iron Deposits in Ontario

A party of Chicago capitalists representing the Insull interests, headed by Martin Insull, and including J. A. McPhail, vice-president of the Great Lakes Power Co.; W. C. Franz, president of the Algoma Steel Corporation, and J. D. Jones, general manager, has gone to make an inspection of the iron-ore properties near Mile 60 on the Algoma Central Ry. in southern Ontario. Exploration work on the deposit has been in progress for some months with satisfactory results, and an expenditure of $200,000 in proving up the property is under consideration, with a view of extensive development if warranted. Mr. McPhail, at a meeting of the Sault Ste. Marie Board of Trade, stated that if the deposit proved as good as expected it would mean that Canadian mills would no longer be dependent on American ore.

Russian Soviet Wants Private Capital for Mine Development

New Mining Code Established—Figures Show Industry Dead—Platinum Monopoly Proposed—Foreign Help Needed

THE *Ost Express* says that Soviet Russia's mining industry, which especially suffered from the effects of the revolution, is now being regulated by the law regarding the natural riches of the earth and their exploitation, which has just been ratified. The purpose of this new law, which is believed to create to a certain extent a legal basis for private initiative, is to remove all discord regarding mining legislature. According to Reuters service the fundamental clauses of the new law stipulate that the riches of the earth are to be exploited by the State itself as well as by private companies, private organizations, private persons, or juridical persons. Foreign, private, or juridical persons must apply for mining concessions to the Council for Labor and Defence. The State, however, also has the right to declare a certain area as "free" for mining enterprises, which means that any person is entitled to exploit it. The title of the discoverer is safeguarded by a grant for the right of "prospecting, digging, and exploitation" for a fixed area. A strict interpretation of the meaning of prospecting and digging is made. Prospecting means only the establishment of the existence of the valuable mineral. Digging, however, means the actual finding of the mineral deposits. The right of exploitation is granted only after the actual finding, but in such a case for a long period. This stipulation of the law is intended to encourage prospecting.

The new law, which also contains protective stipulations against careless working and speculation, will be published as a Mining Code, together with detailed decrees and old regulations from the first days of the N.E.P., so that the code will be a comprehensive collection of the entire mining legislature of the Soviet Republic.

The Krivorog district produced in 1913 400,000,000 poods (36 lb.) of iron ore, part of which was exported. At present only three main establishments are working; these produced 7,000,000 poods in 1922 and are to produce 10,000,000 in 1923. Owing to the lack of sales and transport possibilities 80,000,000 poods had to be put in store, of which it is hoped to consume 20,000,000 in the current year. It is expected that the firm of Krupps will require about 2,000,000 in 1923. The Ural region is the only other district of importance for the production of iron ore. Only six out of eleven establishments are working and solely for the needs of local foundries.

Manganese ore is being produced in the Ural solely for the needs of local industries (250,000 poods in 1922). As a result of the possibility of export trade, the manganese pits in the Tchiatur and Nikopol districts are of more importance. Before the war these districts exported manganese ore to the value of 12,000,000 gold rubles. An improvement in the position of these mines was noticeable last year. Nikopol, for instance, sold 1,000,000 poods to Krupps and smaller quantities to other firms through the Foreign Trade Commissariat. The production reached 20 per cent of the pre-war quantity.

The copper production in the period October, 1922, to March, 1923, amounted to 30,000 poods, against 1,000,000 poods in the same period before the war. From October to December, 1922, 22,000 poods was produced, but in the period January-March, 1923, only 8,000 poods was produced. The Ural copper mines, which formerly were the chief producing centers for copper, were not in operation in 1921, but some work was done there last year.

In the production of gold and platinum, efforts are being made to centralize all the big concerns. During the last quarter of 1922, 200 kg. of platinum was produced, against 16 kg. in 1921 and 1,300 kg. in 1913. A bill has been drafted for the creation of a platinum monopoly stipulating that all purchases of platinum in the Ural are to be carried out by the Uralplatin Trust and the Commissariat for Finance. In the last quarter of 1922 the total gold production amounted to 1,428 kg., against 816 and 9,000 kg. respectively in the corresponding periods of 1921 and 1913. It is expected to increase the production as a result of the facilities offered in respect of obtaining concessions.

Of the Lena streams the Feodossieff deposits are the only ones where work is continued energetically. The production of Lena gold in the last quarter of 1922 amounted to 1,170 kg.; of Ural gold to 76 kg.; of Jenissei gold to 70 kg.; and in the Bashiri Republic to 81 kg.

The reconstruction of the mining industry of Russia will hardly be possible without the aid of foreign capital, but negotiations for this purpose have come to a standstill since the refusal of the Soviet Government to ratify the Urquhart concessions.

Starting of New Cornelia Flotation Plant Set for October

The New Cornelia Copper Co. is proceeding rapidly with the erection of the new concentrator at Ajo, Ariz., and it is promised that the first unit of the flotation plant will be completed by October. The completion of the new plant for treating the sulphide ores will mean the present output of copper by this mine will be more than doubled. If the first unit is put in operation as planned, there will be a substantial increase in New Cornelia's production during the last quarter of the year. The current output is about 3,700,000 lb. per month, this coming from the leaching of oxidized ores.

Eureka Hamburgh Will Open Old Mines at Eureka, Nev.

Tests Show Practicability of Treating Low-Grade Ore—Uncle Sam Adit Undercuts Hamburgh Ore

The Eureka Hamburgh Mining Co. has been incorporated to operate the Hamburgh and Uncle Sam mines, situated in the old Eureka district in Nevada. The new company is already considering the erection of a flotation and cyaniding plant for its low-grade ore, expecting to ship high grade to the Utah smelters over the Euraka & Palisade Narrow-gage railroad.

The company expects to mine at least 50,000 tons of ore that will assay about $15 per ton in the Hamburgh ground, and the Uncle Sam ground gives promise of good ore. Not long ago two samples taken from across 5 ft. of ore in the Uncle Sam ground assayed 1.2 oz. gold and 93 oz. silver. The Uncle Sam company, previous to the consolidation, experimented to determine the best kind of treatment for its ore, which contains gold, silver, and lead, the lead being partly oxidized. The gold is free. The results so far reported are favorable both in the extraction and in the consumption of reagents. At the mine 320 ft. will have to be driven in the Uncle Sam adit before reaching the Friday shaft in the Hamburgh mine workings.

Though the adit will cut only about 300 ft. below the surface, the Hamburgh has been prospected to a depth of 850 ft.; but there has been no extensive stoping. About 10,000 ft. (linear) of working has been driven in the Hamburgh mine, one-fifth of that exploration being on the bottom level. Between the 450 and 850 are extensive workings, but no ore has ever been removed. Above the 450 the richer ore has been mined, but there remain large reserves of low-grade material. It is expected that all ore assaying over $7 a ton will net a profit in milling. The reserves of low grade may amount to 40,000 or 50,000 tons. The possibility of opening high grade can be ascertained only by actual mining.

The Uncle Sam and Hamburgh mines are on the same lode as the Eureka Croesus, the Helena Mortimer, the California, Silver King Connolly, and Dunderberg claims, which have produced well in former years. The break on which all these mines are situated extends from the Jackson mine, at Ruby Hill, 10 or 12 miles to and beyond the old and rich Page, Corwin, and Windfall mines and still further to Newark Canyon. On this same break the Eureka Croesus Mining Co. recently struck a rich body of ore in a winze which was opened on a 30 deg. incline from the bottom of the Catlin shaft, 500 ft. from the south end of Sentinel mine, at a depth of about 750 ft. below the surface. That is the greatest depth in Eureka district, except Ruby Hill. The Uncle Sam Consolidated has opened five shoots of milling ore in which there is more or less high grade and is developing three of them.

Cripple Creek Operations and Output on the Up Grade

Old Gold District Will Produce $5,000,000 in 1923—Better Terms Stimulate Leasing

The first six months of 1923 show a decided improvement in conditions in the Cripple Creek district. The output has increased decidedly over that of a like period last year, and for 1923 will probably be 25 per cent greater than during 1922, or approximately $5,000,000.

During the early part of the year operations were somewhat restricted on account of labor shortage, particularly of machine men, but conditions are gradually improving, and though there is still a shortage, it no longer curtails output.

The revival has been particularly noticeable in the reopening of old properties and in the activity of leasers, which has resulted in numerous discoveries of rich orebodies in old workings or in surface exploration work. This will be reflected in a greater output during most of the last half of the current year.

Among recent events is the taking over of the old El Paso mine by the newly organized Beacon Hill Mining & Milling Co. Development and exploration work has given promising results, especially on the 1,100 level.

The old Isabella company has been reorganized, and a new hoisting plant and surface buildings are being constructed to replace the old plant which was destroyed by fire five years or so ago. The company will start extensive developments as soon as the buildings are completed, and make liberal terms to lessees. The new company is known as the Empire Lee Mining Co.

The Neusta Ventura Mining Co., which recently bought a controlling interest in the Free Coinage, during last month opened up a new oreshoot which the management estimates will yield at least $50,000.

Work in putting the Moon Anchor in first-class condition for active development and mining is about completed; shipments will begin during the latter part of the month.

Recent strikes in the vicinity of Bull Hill have brought new life to this part of the district. Discoveries on the Deadwood, Delmonico, Pueblo, and at Altman will add largely to the output from this section.

A progressive movement has been initiated by many of the holding companies in a general reduction of royalties to lessees with more liberal working privileges. This has resulted in a large increase in leasing operations throughout the district.

Adding to the revival of mining interest, Carl Sextus, an old-time prospector, recently made a discovery in the bed of Cripple Creek of a half pound gold nugget of an approximate value of $400. In the old days there was considerable placer mining in this vicinity, but it was supposed that the gold came from a source higher up.

Granby Suspends Work at Copper Mountain

Operations of the Granby Consolidated Mining, Smelting & Power Co. at the Copper Mountain, and the Allenby concentrator near Princeton, B. C., have been temporarily discontinued, and virtually all men have been released. The sudden cessation of the work after the organization had been completed and operations were under way is attributed to complications arising in connection with the rebuilding of the railway from Princeton to the mine. No announcements at this time are forthcoming as to when operations will be resumed. The property was only recently acquired from the defunct Canada Copper Corporation.

Metalurgica Mexicana-A. S. & R. Deal Approved by Court

Smelting Company Will Revamp Plant at San Luis Potosi—Mines To Be Financed

Subject only to protest from about 10 per cent of the security holders, the Federal Court in New York has approved the plan of reorganization of the Compania Metalurgica Mexicana whereby the mining and smelting operations of the company in Mexico will be financed and directed by the American Smelting & Refining Co.

In fulfillment of its part the A. S. & R. Co., has deposited $600,000 with the Metropolitan Trust Co. subject to order of the reorganization managers. It agrees to remodel the smelter at San Luis Potosi, so that it can treat 20,000 to 30,000 tons of ore a month. This will cost between $1,000,000 and $1,500,000. The intention finally is to have this smelter take the place of the present Aguascalientes plant, as the San Luis Potosi location is better.

The A. S. & R., also agrees to provide funds for equipping and developing the mines of Compania Metalurgica in vicinity of Santa Barbara, and to furnish money for satisfying receiver's certificates and expenses and most of cost of reorganization, that will total over $600,000.

Earnings of the holding company are to be divided as follows: 60 per cent to payment of 5 per cent dividends a year upon debentures and their retirement at $110 a share; the remaining 40 per cent accruing to the benefit of holders of present securities and obligations of Compania Metalurgica. After the retirement of the debentures, 70 per cent of the earnings of the new company will accrue to Metalurgica holders and 30 per cent to A. S. & R. Co. for its risk in its investment and its operating and managing charges. Holders of Potosi and Rio Verde Railway bonds will retain their securities. Potosi & Rio Verde is a subsidiary of Compania Metalurgica. Holders of guaranteed securities of Compania Metalurgica are to receive 50 per cent of their face value in 70 per cent preferred cumulative stock, and 100 per cent in no par common stock.

Fire Sweeps Goldfield, Last Rich Bonanza

Only Six Stone Buildings Left—Nevada Town Once Housed 30,000—A Page of History

Fire said to have been started deliberately in the old tenderloin district, as an episode in a bootlegger's feud, wiped out the town of Goldfield, Nev., on July 6. Six stone or brick buildings, say the dispatches, remain: the T. & T. railroad station, the hospital, Cook's banking house, the postoffice, the Goldfield Hotel, and the old office of the Goldfield Consolidated Mines Co. The town which at one time had a population of 30,000, and from whose wonderfully rich mines more than $100,000,000 in gold was mined in a few years, was really nothing but an empty shell when the fire virtually erased it from the map. The population could not have been more than a few hundred on July 6. Since 1918, when the Consolidated shut down its mill, lessees have been gouging a few tons of ore from the old workings, and the Goldfield Deep Mines Co. has been sinking a new exploring shaft when it could get the money, but the once thriving town was a ghost of its former self.

Gold was first discovered in 1903; the boom started in 1906. On Sept. 15 of that year Joe Gans and "Bat" Nelson staged their famous fight; brokers came; a stock exchange was formed to trade in a hundred wildcat stocks—and a few good ones—and dozens of fortunes were made and lost every day. Gamblers, crooks, adventurers, miners, and speculators flocked to the town. The Northern and scores of other saloons and gambling houses offered entertainment to the 30,000 inhabitants twenty-four hours out of every day. The Hayes-Monette and other rich leases shipped millions of dollars worth of fabulously rich ore; "high-graders" thrived; a tempestuous labor war followed. The miners, who were able to steal anywhere from $50 to $100 worth of high-grade, which the so-called assay offices purchased at a huge discount, objected to being compelled to change clothes going off shift.

When the smoke finally cleared away, George Wingfield was in command. He organized the Goldfield Consolidated and built the "big" mill. The population dwindled by 1909 to about 4,000. In September, 1910, the law prohibiting gambling became effective and Goldfield became a quiet, law-abiding but prosperous mining camp. The tawdry glamour was gone. The shallow mines were gradually worked out; the mills shut down. The camp was dead, but a few of the folks wouldn't admit it. Now the hundreds of wooden shacks and few comfortable homes are gone. To the residents it is a hard blow; to the mining industry the burning of Goldfield is significant only in that it refreshes the memory of a camp that was discovered, rose to dizzy heights, and came to earth in less than twenty years.

Utah Copper Co. Is Building 88 Brick Houses for Employees

Comfortable Dwellings for Married Men Near Mines and Mills—Helps Labor Situation

The Utah Copper Co. is adding largely to its equipment in the shape of new houses for its employees. Eighty-eight new five-room brick houses are to be built—fifty in Garfield, and the remaining thirty-eight to be divided between Magna and Bingham. The new construction will bring the number of houses in Garfield to 500. In this way the housing shortage, which has been acute, since the resumption of milling operations, will be relieved. Privately owned dwellings were in many cases allowed to run down during the post-war depression, so that it has been difficult to accommodate all employees of the mills at Garfield and Magna, and a considerable number of men, who would have preferred living near their places of employment have been forced to live in Salt Lake City.

Utah Mine Dividends Totaled $4,983,992 in First Half of 1923

Utah Copper Led, But Lead-Silver Camps Were Prosperous—Reaction Is Anticipated

The first half of 1923 has been a period of heavy production by Utah mines and increased dividend payments. The completion of the $1 silver purchases will cut down the profits for most of the mines, however. In the first two quarters of 1923 there was paid $4,983,992, compared with $2,457,510 in the same period of the year preceding.

The list of dividend payers includes the Chief Consolidated, $178,442; Iron Blossom, $50,000; Park City Mining & Smelting, $197,100; Park-Utah Mining, $300,000; Silver King Coalition, $364,830; Tintic Standard, $291,325; Utah Apex, $264,000; Utah Copper, $3,248,980. Of the total of $4,983,922, the camp of Bingham, represented by the Utah Copper and the Utah Apex companies contributed $3,512,980; the Tintic district, represented by the Chief Consolidated, Tintic Standard, Iron Blossom and Eagle & Blue Bell, paid $609,082; and Park City, represented by the Park City Mining & Smelting, Park-Utah, and Silver King Coalition, paid $502,720.

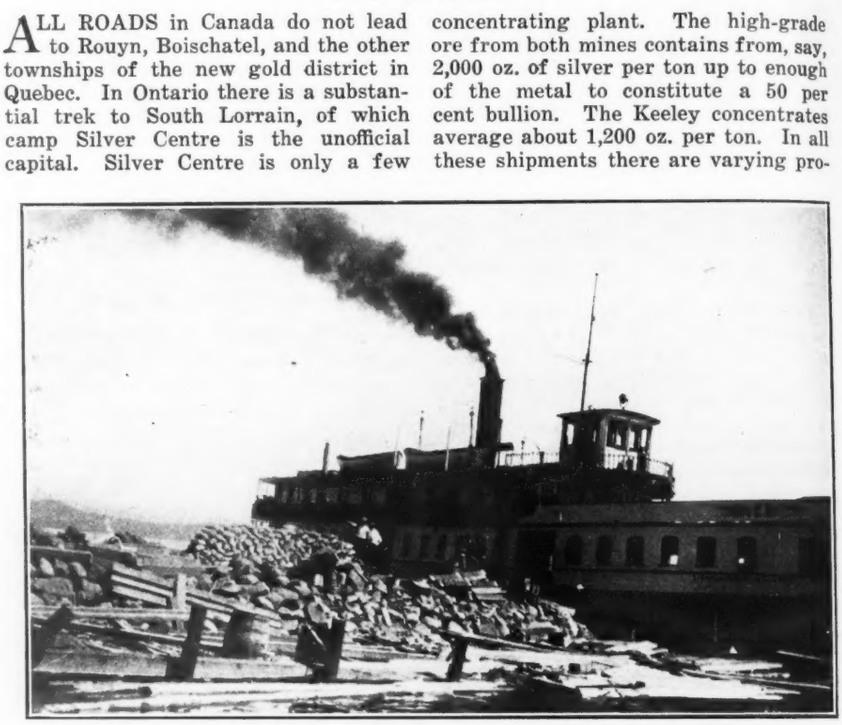
Great gain was made in the amount of ore produced—Park City raised its production to 131,460 tons of ore and concentrates, as compared with 70,858 tons during the first half of 1922. Production by this camp is as follows: Keystone, 4.118 tons; Ontario, 10,432; Park City Mining & Smelting, 35,046; Park-Utah. 43,116; Silver King Coalition, 38.698. Tintic broke all records of production. although the gain over the first half of 1922 as compared to that of Park City is not so great, since in that year the production was already exceptional.

South Lorrain Shares Honors with Quebec Gold Fields

Many Prospectors in Ontario's Newest Bonanza Silver Camp—Keeley and Frontier Active Producers

By J. C. Murray

ALL ROADS in Canada do not lead to Rouyn, Boischatel, and the other townships of the new gold district in Quebec. In Ontario there is a substantial trek to South Lorrain, of which camp Silver Centre is the unofficial capital. Silver Centre is only a few hours' travel southeast from Cobalt. Men, equipment, and supplies are being shipped in steadily, and silver, in the form of high-grade ore and concentrates, is being shipped out to the amount of well over 300,000 oz. per month. These shipments will soon be increased through the enlargement of the Keeley mill. For a fortnight before the belated opening of navigation on Lake Temiskaming, the 18-mile road to North Cobalt was impassable to freight teams. Strong representations have been made to the Ontario Government regarding the urgent need of having the road macadamized as rapidly as possible



Loading concentrate from the Keeley mine, on Lake Temiskaming

There are at present but two producing mines in the district, the Keeley, belonging to the Keeley Silver Mines, Ltd., of which J. Mackintosh Bell is managing director, and the Frontier mine, owned and operated by the Mining Corporation of Canada. M. F. Fairlie is the general manager of the corporation's Cobalt and South Lorrain properties. The Keeley is equipped with a 20-stamp mill. The high-grade ore is bagged in the mine and as it comes from the mill sorting table, and both high-grade and concentrates are shipped to the O'Brien smelter, at Deloro, Ont. There is no mill on the Frontier, and high-grade only is shipped. The mill rock is being stored in stockpiles pending the erection of a concentrating plant. The high-grade ore from both mines contains from, say, 2,000 oz. of silver per ton up to enough of the metal to constitute a 50 per cent bullion. The Keeley concentrates average about 1,200 oz. per ton. In all these shipments there are varying proportions of cobalt, for which there is a slow but fairly assured market.

Both of the operating companies have secured, by purchase or by option, many selected claims in the district and are exploring these systematically. In addition to these activities, not fewer than twenty companies and syndicates have either started development work on other properties or are preparing for it. Labor is fairly plentiful, and electric power is obtainable at a moderate price.

The first recorded discovery of silver ore was made in South Lorrain, on what later became the Keeley property, toward the end of the year 1907. The claim had originally been staked when under snow. The discoverers of the silver were not the original stakers. The Keeley formed the basis of an extravagant flotation, supported by the Farmers' Bank, which institution accepted bonds for $1,000,000 in cash. The Farmers' Bank collapsed soon after this indiscretion. The Keeley struggled along for a time and then suspended operations. An adjoining property, the Wetlauffer, produced about 3,000,000 oz. before sharing the same fate. In 1912, Mr. Bell secured an option for his London principals and work was begun on the property in most discouraging circumstances. It was continued, despite the scoffs and gibes of many outside critics. Bonanza ore was

struck in the autumn of 1921, and the property has become one of the outstanding producers of the North.

The Frontier property was first opened up in the summer of 1910, by the Haileybury Frontier Mining Co. In 1912 it was closed. Once more it was opened up in 1916, but only for a brief space. It was finally acquired in the autumn of 1921 by the Mining Corporation. In its first year the output of silver totaled 508,000 oz, all from high-grade ore. During the first six months of this year, the output has been about 750,000 oz. Although less developed than the Keeley, and, consequently having less demonstrated ore in reserve, it has the promise of a long and profitable life.

Hammon Company's Two New Dredges at Work Near Nome

Seven Operating Boats Should Make Big Output this Summer—Diesel Engines Supply Power

The Hammon Consolidated company launched its two new gold dredges at Nome about June 1. A holiday was declared at Nome and practically everyone in the camp was present to watch the big hulls slide down the ways and get ready for the season's work. These dredges, which were built by the Yuba Construction Co., are equipped with 9 cu.-ft. buckets and are capable of digging to depths of over 70 ft. The hull of one dredge is 140 ft. long and of the other 115 ft. They are electrically driven, the power being supplied by two 525-hp. Diesel engines. The power plant is just outside the city limits of Nome, and the dredges will start digging on Little Creek and Anvil Creek, about five miles from the power plant.

The Hammon company will be the largest operator in the Nome district. It purchased last year all the holdings of the Pioneer Mining Co. and will operate not only the two dredges but several of the hydraulic lift mines which formed the main workings of the old Pioneer company. The material for the dredges was landed at Nome late last summer, and the hulls were built and the machinery was assembled during the winter. The Nome district should make a good production this summer, for it is announced that seven dredges will be digging throughout the season.

Salt Lake City Will Be Home of Major Experiment Station

Bureau of Mines Recognizes City as Metal-Mining Center—Appropriations Are Necessary

There has been no abandonment of the early hope of the Bureau of Mines to establish in Salt Lake City a large central experimental station comparable to the one which has been maintained at Pittsburgh. Salt Lake City is recognized as being the logical center at which the work on many of the problems common to the metal mining states could be performed. The success of the plan applied at Pittsburgh now has been established. To carry out the program for a similar center of research at Salt Lake City necessarily must wait on appropriations. There has been no announcement as to when such an appropriation will be requested. A project frequently is affected adversely by such a request at an inopportune time. It can be stated authoritatively, however, that careful consideration is being given the matter at this time.

With the removal of Bartlesville and Fairbanks from experiment stations coming under the Foster authorization, there remain three stations authorized by that act, which can be appropriated for at any time Congress sees fit without having to secure special and specific authorization.

Representative Cramton, of Michigan, who will be the chairman of the Committee on Appropriations in the next House, will be in a position to have first-hand knowledge of the needs of the mining industry in the West, as he is spending his time during the interim between Congresses in visiting points in those states where the federal government is expending money.

Office and bunkhouse at the Keeley mine in South Lorrain, Ont.

Two New Zinc Smelters Planned for Amarillo, Texas

Decision Said to Hinge on Negotiation of Satisfactory Contract for Natural Gas

Two new zinc smelters are soon to be constructed at Amarillo, Tex., if negotiations which are pending for the purchase of a supply of natural gas for fuel are successfully concluded, according to authoritative statements. One of the proposed plants is to be built by the American Metal Co. and the other by the New Jersey Zinc Co., according to information given by persons interested.

The United States Zinc Co. recently constructed and placed in operation here two blocks of a five-block zinc smelter. It obtains its natural gas supply from the Amarillo field, and has a ten-year contract by which it is to pay 5c. for each 1,000 cu.ft. for the first three years, 6c. for the ensuing two years, 7c. for the next two years, and 8c. for the last two years of the contract.

In large measure the Amarillo plant is taking the place of that at Sand Springs, Okla., abandoned in 1921, after operating seven years, with the waning of the gas supply. The coal plant that was operated in Colorado has also been abandoned.

Tombstone Lessees Find Ore

Good Shipments from Phelps Dodge Toughnut Mine

Benson & Alberts, lessees of the Silver Thread and Toughnut mines, at Tombstone, Ariz., report the discovery of a new orebody in the Toughnut mine that promises to supply them with ore for shipment for some time. The ore is rich in both gold and silver; the first car shipped to the Douglas smelter averaged about $255 per ton.

The new orebody was first encountered on the 300 level, and is associated with ore of the district's major anticlines, called locally the "Quarry roll." It was necessary for the leasors to repair about 1,200 ft. of old drift, sink a winze 110 ft. and drive a drift on the 300 level in order to open the ore.

The Toughnut mine was one of the district's greatest producers many years ago and much high-grade ore was shipped from the orebodies occurring along the Toughnut and Quarry "rolls." Benson & Alberts recently discovered high-grade silver ore in the Silver Thread mine, from which they have been shipping regularly, but this ore is in no way associated with the new discovery in the Toughnut. These properties are owned by the Phelps Dodge Corporation, Bunker Hill Branch, and are worked under lease. J. P. Seabring, who has been milling the dump at the Contention mine with his cyanide equipment, will soon move to the Toughnut shaft for treating the old dump at that place. Profits have been realized from many of the old dumps in the district by discarding the large material and treating the fines in solution tanks.

News from Washington

By PAUL WOOTON
Special Correspondent

Mint Records "Adjusted" to Lend Color to Silver Revocations

The 10,247,976 Oz. Involved Was Actually Converted Into Subsidiary Coins—Facts Misrepresented to Comptroller General —Resubmission Demanded

Senator Pittman Proposes:

THAT the matter of the revocation of the silver allocations in question be resubmitted to the Comptroller General on whose former decision the Mint officials base their case; and that the vital facts developed from official correspondence and from testimony of high Mint officials be submitted at the same time.

The Senator has written a formal letter of 5,000 words to Under Secretary Gilbert. A large part of it is printed herewith.

Hon. S. Parker Gilbert, Jr.,
Acting Secretary of the Treasury,
Washington, D. C.

My dear Mr. Secretary:

I respectfully request you to petition the Comptroller General for a rehearing upon your application of Nov. 2, 1922, for a decision upon the authority of the Treasury Department to revoke allocations of standard silver dollars and other silver for subsidiary coinage under the terms of the Act of April 23, 1918, sometimes known as the Pittman Act. This request is based upon the following grounds:

You stated that you were controlled by the decision of the Comptroller General made on Nov. 29, 1922, in response to your request for such decision. That decision was based upon a statement of facts submitted by you in your application. Such statement of facts is incorrect and was misleading. It has been positively contradicted and disproven by the testimony of Miss M. M. O'Reilly, Acting Director of the Mint during the period when such allocations were made, and by the special auditor of the Senate Commission of Gold and Silver Inquiry, and by the contemporaneous correspondence of the Treasury Department bearing upon the subject and placed in evidence at the hearings of the subcommittee of such commission and now a part of the record which is submitted herewith.

The following are the allocations that you asked authority to revoke: Sept. 7, 1918, 1,000,000 standard silver dollars; Nov. 28, 1919, 10,000,000 standard silver dollars; Nov. 6, 1920, 111,168 standard silver dollars; and a balance of 1,658,246.39 oz. of the 6,000,000 oz. allocated Oct. 18, 1920, and Dec. 18, 1920; totaling 10,247,976.52 fine ounces.

In your statement of facts to the Comptroller General requesting authority to revoke these allocations you said:

"The result of these transactions is that the Mint Service now carries in its subsidiary silver account silver bullion amounting to 10,247,976.52 fine ounces, remaining from allocations under the Act of April 23, 1918, for which there is no present demand for the purpose of subsidiary coinage." (Tr. p. 284.)

The evidence shows conclusively that this statement is not true. Not a single ounce of that silver remained in the subsidiary silver account at the time your application was made on Nov. 2, 1922. Every ounce of it had been used for subsidiary coinage. I call your attention to the evidence contained in the hearings which I herewith submit to you. The following was adduced while Miss O'Reilly, Acting Director of the Mint, was testifying:

"Senator Pittman. What did the Director of the Mint then cause to be done with those 10,000,000 silver dollars?

"Miss O'Reilly. He caused subsidiary coin to be made." (Tr. p. 264.)

Mr. W. E. Reid, of the firm of F. W. Lafrentz & Co., public accountants, 100 Broadway, New York City, who for over two months has been auditing the accounts of the Philadelphia Mint and the Treasury Department bearing upon such allocations, under oath testified as follows with regard to the 10,000,000 standard silver dollars allocated Nov. 28, 1919:

"Senator Pittman. What happened to the 10,000,000 standard silver dollars so allocated?

"Mr. Reid. The 10,000,000 standard silver dollars were delivered to the melting department of the Philadelphia Mint in lots between Dec. 5, 1919, and March 22, 1920.

"Senator Pittman. Then what was done with these silver dollars?

"Mr. Reid. As shown by the make-up room daily reports of the Mint the silver dollars were melted between the dates of Dec. 5, 1919, and March 29, 1920.

"Senator Pittman. Then what became of the silver resulting from this melting?

"Mr. Reid. The silver bullion derived from this melting was made up into denominal ingots.

"Senator Pittman. What kind of ingots?

"Mr. Reid. It was made into half-dollar, quarter-dollar, and dime ingots.

"Senator Pittman. What then became of these ingots?

"Mr. Reid. They were delivered to the coinage department from time to time as requisitioned.

"Senator Pittman. What do the records of the Philadelphia Mint show that the coinage department did with these ingots?

"Mr. Reid. That they were all coined into denominal coins, that is, dimes, halves, and quarters."

So none of that silver was remaining in the subsidiary silver account three years later when you wrote your letter to the Comptroller General on Nov. 2, 1922. [Similar evidence regarding other allocations was introduced.]

Can it be successfully asserted that the 10,247,976.52 fine ounces of silver was not required for the purposes for which allocated when it has been conclusively proven that it was actually coined under your orders?

The foregoing evidence is all corroborated by other evidence, by the orders, correspondence, books of account, and reports of the auditors, which are embraced in the hearings upon this subject and submitted for your consideration.

I call your attention to the following letter showing the condition of the subsidiary silver account at your largest mint on Nov. 26, 1919:

"Nov. 26, 1919.

"The Honorable
"The Secretary of the Treasury.

"Sir: I beg to state that the stock of silver on hand at the Mint in Philadelphia available for subsidiary coinage is only a little over one million ounces. The Mint is using approximately eighty thousand ounces a day in the manufacture of subsidiary coins.

"I have the honor to request authority to take from the stock of silver dollars now in the Mint at Philadelphia the sum of ten million dollars to be melted and used for subsidiary coinage of the United States, in accordance with the provision of the Act of April 23, 1918.

"Respectfully,
"M. M. O'REILLY,
"Acting Director."
(Tr. p. 261.)

If there was available silver in the subsidiary silver accounts of the other mints at that time, why was it not transferred to the Philadelphia Mint instead of allocating 10,000,000 standard silver dollars?

The report of the Director of the Mint for 1919 and the report of the special auditor for our commission show that all of that silver was melted up before March 23, 1920. The melting up commenced on Dec. 5, 1919, and at that time the coinage requirements of that mint alone were 80,000 oz. a day. At this rate the 7,816,732.24 oz. of silver contained in the 10,000,000 standard silver dollars would be used for coinage about as fast as it could be melted. [Other letters showing the situation at subsequent dates follow.]

The following letter proves that the Treasury Department has violated the Act of April 23, 1918, by coining standard silver dollars from bullion obtained from recoinage silver to replace those melted up instead of coining such standard silver dollars from silver purchased in the United States of the product of mines situated in the United States. Mr. Frantz, the auditor, testified that recoinage silver consists of uncurrent, lightweight, abraded coin. (Tr. p. 327.) This letter and similar letters hereto attached disclose the great difficulty that the Mint was experiencing at that time in accumulating enough silver from the refined and unrefined silver of all kinds in all of the mints and the New York assay office from which to recoin such standard silver dollars which had been melted up, and yet the coinage of subsidiary coin had been discontinued prior to Feb. 11, 1921, and had not been resumed at the time such letters were written. The letter to which I refer is as follows:

"Treasury Department,
"Washington.
"Dec. 19, 1922.

"Superintendent,
"United States Mint,
"Philadelphia, Pa.

"Sir: The Secretary of the Treasury has revoked the allocations heretofore made of silver dollars and Pittman silver bullion for use in the manufacture of subsidiary silver coin. Such revocation was sanctioned by opinion of the Comptroller General of the United States dated Nov. 29, 1922. The revocation is premised on the fact that more than the quantity of silver so allocated has been constantly on hand in the various institutions of the mint service since such allocations were made, although in an unrefined state or not at the institution where needed and thus not immediately available for use in the manufacture of needed subsidiary coin. The revocation has the effect, in part, of avoiding permanent investment by the government of approximately $8,500,000 in silver bullion not needed at the present time; it also saves the interest charges on the amount of money which otherwise would have to be borrowed for use in purchasing the bullion.

"The revocation involves certain adjustments in the accounts but these will be handled at the other institutions since you have no refined subsidiary silver bullion which could be made available for manufacture of dollars.

"It is the desire of the department that all silver bullion which is in condition for coinage be made into standard silver dollars as rapidly as possible. The accounts show that there is a fair stock of recoinage silver bullion at each of the three mints, and it is the desire of the department that this bullion also be used in the manufacture of dollars, and that unrefined bullion be carried in lieu thereof until the Pittman bullion has been converted into dollars and until such time as it is practicable to refine a sufficient quantity of the unrefined bullion on hand to produce the subsidiary recoinage.

"In order to make all the recoinage silver metal available for use in the manufacture of dollars it will be necessary that certain adjustments be made between mint service institutions. These adjustments will be book adjustments only; no silver will be physically transferred from one institution to another and there will be no change in the combined figures of the three mints as regards total quantity and value of silver in the recoinage accounts, the subsidiary silver accounts, and the Pittman silver accounts. For your own institution it is directed that on Dec. 26, you transfer in your accounts 2,100,000 oz. silver, valued at $2,903,058.58, to the mint at Denver from your recoinage account; and that you transfer to your Pittman silver account from the mint at Denver 2,100,000 oz. silver at a value of $2,100,000. You will also transfer in your accounts 400,000 oz. silver valued at $552,963.54 to the mint at San Francisco from your recoinage account, and transfer to your Pittman silver account from the mint at San Francisco 400,000 oz. silver at a value of $400,000. These transfers will enable you to make into silver dollars practically all (2,500,000 oz.) of the recoinage bullion now carried at the Philadelphia Mint.

"These transfers should be recorded and reported in the same manner as though the bullion were physically transferred. The Treasurer's office is being informed concerning them.

"Respectfully,
"F. E. SCOBEY,
"Director of the Mint."
(Tr. p. 315.)

Similar letters were written to the other mints and to the New York assay office. I attach hereto copies of the other letters addressed by the Director of the Mint to the various mints and to the New York assay office for the purpose of exposing the methods used to sustain the inferences that could be gathered from your statements submitted in your letter to the Comptroller General seeking sanction of your desire to revoke the allocations.

[Miss O'Rielly and Mr. Frantz, in explaining the reasons for the altering of the accounts at the various mints and the New York assay office, testified that until the opinion was rendered by the Comptroller General the Treasury Department treated said allocations as sales, but that after said opinion was rendered that department treated the allocations as loans.]

Means $3,500,000 to Silver Producers

IF THE Comptroller General, in possession of all the facts, reverses his former ruling, the government, through the Mint, will be obliged to increase the Pittman Act purchases by 10,247,976 oz. Based on the current market for silver, this will mean a realization of $3,500,000 for domestic silver producers.

The fact should be emphasized that this is in no sense a subsidy; it is merely the fulfillment of an equitable undertaking on the part of the government.

I cannot imagine that the Comptroller General ever intended that his decision should be construed as holding that the allocations of standard silver dollars for subsidiary coinage could be treated as a loan or that such silver dollars when melted and used for subsidiary coinage, under the Act of April 23, 1918, could be replaced by standard silver dollars coined from recoinage silver or silver obtained from any other source than that provided in the act. Your statement in your letter to the Comptroller General of Nov. 2, 1922, to the effect:

". . . that from November, 1919, to date there has been continuously on hand in the subsidiary silver accounts of the Mint Service an amount in excess of 11,000,000 fine ounces, some of which has been partly unrefined." (Tr. p. 284.)

was undoubtedly construed by the Comptroller General in connection with your other statement contained in the same letter that:

"The result of these transactions is that the Mint Service now carries in its subsidiary silver account silver bullion amounting to 10,247,976.52 fine ounces, remaining from allocations under the Act of April 23, 1918, for which there is no present demand for the purpose of subsidiary coinage." (Tr. p. 284.)

The Comptroller General's statement in his decision that "Nothing appears why the balance of the allocations may not be revoked if the silver allocated for subsidiary coinage is not needed for that purpose" sustains me in this conclusion.

. . . The evidence proves conclusively that all of the silver in the 10,247,976.52 oz. revoked by sanction of the Comptroller General was actually used for subsidiary coinage. In these circumstances, it would seem absurd to argue that such silver was not required for the purposes of such allocations. Undoubtedly the Comptroller General must have understood from your letter that such silver was never used, was still on hand in the form of bullion, and was not needed for subsidiary coinage at the time that your letter was written to him on Nov. 2, 1922.

You answer my argument relative to the revocation of the allocations of such silver by stating that you are bound by the decision of the Comptroller General. As the representative of the committee of the United States Senate charged with the duty to investigate this matter, I propose that we submit the facts obtained at the hearings of the committee to the Comptroller General. Such facts were not in his possession at the time he rendered his opinion, and, in my opinion, a consideration of them will impel him to reverse his decision. I am satisfied that he will willingly grant the rehearing upon your request. I will be pleased to have an early reply to this communication as I am very desirous of departing for the West on business of this committee.

Sincerely,

(Signed) KEY PITTMAN,
Chairman of the subcommittee and vice-chairman of the Senate Commission of Gold and Silver Inquiry.

War Minerals Relief Awards

John Briar, the War Minerals Relief Commissioner, has recommended and the Secretary of the Interior has approved the following awards under the War Minerals Relief Act: Silver Edge Mining Co., pyrites, $7,324.31; C. C. Bracken, tungsten, $1,363.40; Sheaffer Bros., chrome, $256; Grants Pass Chrome Co., chrome, $100 additional. Disallowances have been approved as follows: Frank Johnston, tungsten, not within the act; Harry V. Norton, tungsten, not within the act; J. K. McCloy, chrome, no additional award justified; Barton & Cain, chrome, no additional award justified; The Kromore Co., chrome, no additional award justified; Richards Bros., chrome, earlier stimulation not established; Thompson, Trask & White, chrome, commercial importance not established; G. C. Grimmett, chrome and manganese, no further award justified; Moore & Robinson, chrome, earlier stimulation not established; Benjamin F. Steacy, chrome, no additional award justified; Chatham & Britten, chrome, not within the act.

News by Mining Districts

By Special Correspondents in the Field

Johannesburg Letter

Corduroy Tables and De-aeration of Solution Improve Metallurgy—H. Stuart Martin Retires

BY JOHN WATSON

Johannesburg, June 5—At the twenty-eighth annual meeting of the Rand Mines, Ltd., held recently in Johannesburg, the chairman claimed that distinct advances had been made, in the metallurgical department, in various directions, notably:

1. The elimination of amalgamated plates in reduction plants, by which mercurial poisoning is prevented and there is, also, less temptation to thieving. Corduroy-covered tables are now used successfully in place of the amalgamated copper plates, on several mines. This change has been found to effect a saving of about 1d. per ton of ore milled. The quantity of gold in circuit is also reduced and there is more prompt realization of its value.

2. Increased precipitation is effected by the de-aeration of gold-bearing cyanide solutions by the Crowe method. The consumption of both cyanide and zinc is also reduced. The saving thus effected amounts to between 1 and 2d. per ton milled.

The health conditions on the mines of the group had improved during the past year, and the accident death rate of their native labor force had been only 2.39 per 1,000, which constitutes a fresh record. The death rate from all diseases among natives dropped from 11.18 per 1,000 to 9.76 per 1,000, as a result of the efforts of the compound and hospital staffs and of the application of the most hygienic methods for safeguarding the health of the natives.

The retirement is announced of H. Stuart Martin, consulting engineer to the Central Mining & Investment Corporation, Ltd., who has been fifteen years on the Rand. Among the principal developments for which he has been responsible are the new circular shaft and underground haulages at the New Modder, the Modder B and Modder East Mines. He has also been prominently identified with the later developments of the Crown Mines, Village Deep, and Ferreira Deep. There were very few circular shafts on the reef before Mr. Martin came to South Africa. He sank several of these, increased the speed of winding from about 3,000 ft. to 4,500 ft. per minute and introduced wire-rope guides. The system of underground haulage has been improved by the introduction of the "main and tail" system.

The annual general meetings of the Barnato group of mines were held in Johannesburg on May 28 and 29. At Government Areas there was a decrease of 268,500 tons in the ore crushed and the revenue at the current price of gold was down £275,869 compared with 1921, yet the working profit showed an increase of £212,194, due to increase in grade and decrease in costs.

At New State Areas, the new plant is said to give promise of being a great success. Crushing in a small way was started on May 1.

London Letter

New Diamond Enterprise—East Rand Proprietary and Cinderella May Co-operate on Pumping

BY W. A. DOMAN

London, June 28—Following the announcement I was able to make a few weeks ago regarding the formation of a company to develop the diamond concession of the Akim (West Africa) comes a story of the probable early appearance of another similar undertaking. The diamondiferous ground covers a large area, and I am told that Chester Beatty, of the African Selection Trust, Burma Corporation, and Metals Production, owns a concession covering some hundreds of square miles. Rumor states that he has refused the offer of a handsome sum for his interest, which will be dealt with as a separate undertaking. The diamonds from the district are generally small, but they command a ready market here, and the output is increasing.

The East Rand Proprietary, which, owing to its position and depth, drains a large area in the Eastern Rand, has been unfortunate. Pumping is the heaviest item in the company's expenditure, and the ore is low in grade, so the company approached the Union Government for financial assistance, in order to avoid closing down and thus putting its own employees and those on adjoining properties out of work. The government turned down the project, and now the Cinderella (its nearest neighbor) has also refused to make a joint arrangement on the matter. However, the last word has probably not yet been spoken, and as the Cinderella directors are anxious to restart operations, a mutually advantageous plan may be evolved.

The china clay industry of the Federated Malay States has evidently been stimulated by the growing prosperity of the home trade, the centre of which is Cornwall. A local concern which apparently has the moral support of the F. M. S. Government, has obtained valuable concessions, and claims to be able to produce pottery of all descriptions, including porcelain. All raw materials are available, and labor is cheap and abundant, so that the company can supply not only local requirements, but offers serious competition to the West of England industry.

I hear that Deane Mitchell, of the Russo-Asiatic, was so impressed with F. W. Bradley's report on the Mayo property of the Alaska Treadwell, now worked by the Treadwell Yukon Co., that he has decided to make a personal visit to the scene of operations almost immediately. There has been some significant buying of Treadwell shares on the London market recently, but they are somewhat scarce.

Preliminary figures of the General Mining & Finance Corporation, one of the principal controlling houses of the Rand, indicate a greatly improved position. The corporation made an excellent bargain in purchasing about 800,000 exenemy shares of the nominal value of £1 at 2s. per share, and this, together with a working profit for the year of £78,800 and the amount brought forward, has enabled it to wipe out £1,186,000 of depreciation, to reduce holdings to market value, to make provision for possible loss on other assets, and leave a surplus of £11,000. This corporation should soon re-enter the list of dividend payers.

ALASKA

Willow Creek District Active

With ten or more mines in active operation and several hundred men on the payrolls, the Willow Creek lode gold district near Anchorage is starting on the busiest season of its history. A number of the veins are proving up well under development work, and the larger mining organizations are beginning to take an interest in the district. The Kelly Mines Co., in the Willow Creek district, has been driving a crosscut, and recently cut the Skyscraper vein at a point 600 ft. below its outcrop. This is one of the most important pieces of development work in the district. The Skyscraper vein will be explored from this level while the crosscut is continued farther into promising ground.

BRITISH COLUMBIA

Silversmith Pays Dividend

The Silversmith Mines Co., operating at Sandon, B. C., has declared a dividend of $50,000 payable on July 10 to stockholders of record July 2. This is the second dividend this year. The first, of like amount, was declared last January. These dividends represent 2c. per share on the capitalization of $2,500,000.

The forthcoming disbursement will increase the total dividends of the company to $200,000. It is rumored that the net profits for the fiscal year ending May 31 will be in excess of $250,000.

Rio Tinto Group Sold

J. H. McDonald, of Rossland, reports the sale of the Rio Tinto group, in the Salmon River district, to American interests, for a consideration of $60,000. The group has been undergoing development by McDonald for ten years, and promising showings of lead-silver ore have been opened up in two veins. The new owners will proceed with development by sinking two shafts 350 ft. deep.

Rich Gold Ore Reported

A discovery yielding sensational gold values has been made in a ledge discovered near Ewings landing, on Okanogan Lake. The orebody is reported as being 35 ft. wide, and assays obtained from a shaft being sunk show from $10 to $990 per ton.

Will Reopen Whitewater Property

John R. Retallack, of the Whitewater Mines Co., operating near Kaslo, announces that the mine is to be reopened and put on a producing basis. This is one of the Kootenay properties that has been worked recently by lessees. In regular operation it has a production record of 34,477 tons of shipping lead ore having a net value of $1,579,213; and 16,086 tons of shipping zinc ore having a net value of $209,595. From this production a profit of $622,515 was realized.

MEXICO

El Boleo Copper Production Lower

The production of copper from El Boleo mines, in Lower California, for the month of May was 430 tons, against 689 tons the month before. The production for the first five months of this year was 2,851 tons.

Dividend for Potosi Mine

The Negociacion Minera la Victoria y Anexas, of San Luis Potosi, at a recent meeting of the board of directors declared a dividend of one peso per share, payable July 1.

CALIFORNIA

Mill for Royal Flush

Carl W. Chilson is erecting a reduction plant on his Royal Flush gold property, situated 25 miles east of Caliente. Samples of the ore average as high as 10 oz. gold and the average across 3 ft. is said to be 1 oz. per ton. The plant will combine amalgamation and concentration.

NEVADA

Tonopah Curtails—New Ore in Tonopah Extension

Operations in Tonopah have been curtailed, as expected with the readjustment due to drop of 35c. per ounce in price received for silver. The Belmont and Tonopah mining companies are still producing a fair tonnage of ore, and both mills are operating. However, it is likely that during July one of these companies may find it expedient to close down its mill and ship the mine production to a custom mill. West End production remains about normal, and Tonopah Extension operations are normal. The Halifax continues to ship 40 tons of ore per day and extensive development work is being carried on at this property. The Tonopah Extension reports the discovery of a new vein containing high-grade ore on the 1,200 level, several hundred feet westerly from the McCane shaft. This discovery is likely farther west than any other known ore in the district, and is therefore considered important to the district as a whole.

June bullion production for Tonopah was approximately 600,000 oz., containing gold and silver in the approximate ratio of 1 to 100 by weight. This of course will be largely reduced hereafter.

Betty O'Neil Looks Good

The Betty O'Neal mine, near Battle Mountain, is looking exceptionally well. Some high-grade and mill ore has been proved to exist in the hanging wall of a stope above the No. 4 tunnel level, and conditions suggest that other large and important orebodies may be found above what has been considered to be the hanging wall of the vein. The 100-ton flotation mill is operating at capacity, and plans for the additional unit are practically completed.

ARIZONA

Hoatson Shaft To Be Re-equipped

The Calumet & Arizona Mining Co. recently leased the Hoatson shaft to Gilman, Huckley & Armit. These men have finished reconditioning the shaft to the 1,100 level, where they are preparing to start stoping and development. Foundations are being erected for a 100-hp. electric hoist and a compressor, which have been ordered from Denver, and this machinery will be installed as soon as it arrives. Other levels will probably be developed later, depending upon the success of the present work.

High-Grade Ore in Gold Dust

An important strike of high-grade gold ore has been reported at the Gold Dust mine, in the Oatman district. A crosscut that was driven through a dike that had been thought barren revealed an excellent face of ore. A drift now being driven on the ore shows values of $25 to $50 and fine specimens of high-grade have been found. This discovery is stimulating activity in the Oatman district.

OREGON

Bay Horse Resumes Shipping

The Bay Horse mine, at Homestead, has resumed shipments to the Bunker Hill smelter. In April shipping was suspended to facilitate shaft sinking. The shaft has been sunk in the orebody from the upper level and has proved the continuity of the ore downward for an additional 135 ft., with ore still in the bottom of the shaft, according to reliable reports. The development to date indicates an orebody 800 ft. long and 80 ft. wide of milling ore carrying in places high-grade which can be shipped direct to the smelter at a profit. To facilitate the economic handling of the ore a lower cross cut has been started.

Sumpter Valley Smelter Blown In

The Sumpter Valley copper smelter has been blown in on a trial run after being idle several years, according to J. L. Magney, director. The first lot of ore included three carloads from the Bay Horse mine, which will furnish the smelter with siliceous ore. The smelter is receiving shipments from the Herculean, Ibex, Ben Harrison, Buffalo, E. & E., and other properties near Baker. The Copper Syndicate, near Homestead, will also be a regular shipper.

The capacity of the plant is 300 tons of ore daily. The matte will be shipped to the Tacoma smelter for refining. W. E. Fellows is manager and C. Meyers is metallurgical engineer. Twenty men are now employed.

MICHIGAN

Mohawk Regrinding Plant Progresses

Mohawk will install four Hardinge mills in its new regrinding section now under construction at the stamp mill at Gay in the copper country. The steel superstructure has been completed and equipment for the plant will be installed by the mill force. It is expected that one of the units will be in operation by fall and the others within a few months thereafter.

Will Improve C. & H. Smelter

Changes and improvements in the Calumet & Hecla smelter at Hubbell are planned. A group of officials of the company recently inspected smelting plants at Great Falls and other western centers with this object in view.

Youngstown Sheet & Tube Co. Gets Two More Iron Mines

It has been announced by A. D. Chisholm, manager of the Newport mine, in Ironwood, and the Anvil-Palms mine, at Bessemer, that these mines passed into the control of the Youngstown Sheet & Tube Co. the first of this month. Pickands, Mather & Co. are largely interested in the latter concern and are managing several other mining properties in the Lake Superior district in which the Youngstown owns a controlling interest. No changes in the management of the local mines has yet been announced.

THE MARKET REPORT

Daily Prices of Metals

July	Copper, N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
5	14.125@14.25	37.00	37.50	6.35	6.15	5.80@5.85
6	14.125	37.375	37.875	6.25	6.00@6.10	5.85
7	14.125	37.50	38.00	6.25	6.00@6.10	5.90
9	14.125	38.00	38.50	6.10@6.15	5.90@6.00	5.95@6.00
10	14.125@14.25	37.75	38.25	6.00@6.10	5.80	6.05@6.125
11	14.375	38.00	38.375	6.00	5.75	6.15
Av.	14.1875	37.604	38.083	6.171	5.958	5.965

*These prices correspond to the following quotations for copper delivered: July 5th, 14.375@14.50c.; 6th, 7th, 9th, 14.375c.; 10th, 14.375@14.50c.; 11th, 14.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. The quotations are for prompt deliveries. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

July	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
5	65	65 5/8	72	177 1/4	178 3/8	23 7/8	23 1/4	27 7/8	28 1/2
6	64 3/4	65 3/8	72	177 5/8	179	23 3/4	23 1/4	28	28 5/8
9	65	65 5/8	72 1/4	181 3/8	182 5/8	24 1/8	23 5/8	28 3/8	28 7/8
10	65 1/4	65 7/8	72 1/4	180 3/4	181 5/8	24 1/2	24	28 5/8	29
11	65 3/4	66 3/8	72 3/4	181 5/8	182 1/8	24 1/2	23 7/8	28 5/8	29

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London	July	Sterling Exchange "Checks"	Silver New York	Silver London	Gold London
5	4.55	62 7/8	31	90/7	9	4.56	63 5/8	31 3/8	90/4
6	4.56 1/4	63 3/8	31 5/16	90/5	10	4.56 3/4	63 3/8	31 1/4	90/2
7	4.56	63 1/4	31 1/4	....	11	4.58 1/4	62 3/4	30 3/4	89/11

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets

New York, July 11, 1923

Sentiment in the metal markets is much better than last week. Business has picked up somewhat, but is not yet on a large scale, as most consumers are buying very cautiously. Zinc and copper prices are somewhat improved, but lead has declined quite violently owing to the policy decided upon by the leading producer. Tin has held steady.

Copper

Copper has been obtainable until yesterday at the 14⅜c. delivered level which was mentioned in the metal report of last week. Sales at that level were not large, but were sufficient to absorb all that sellers at that price had to dispose of, so that, unless more of the cheap lots appear, the price is likely to ascend rapidly to the 15c. level quoted by most of the selling agencies. Thus will their patience be rewarded. Sales were made today around 14⅝c., with several offers of 14.50c. turned down. It is probable that the morning's business has absorbed all of the offerings below 14.75c.

Press reports are to the effect that stocks of refined copper decreased about 7,000,000 lb. during June and are now about 197,000,000 lb. Refinery production decreased to about 178,000,000 lb., so that foreign and domestic shipments were about 185,000,000 lb., compared with 190,000,000 lb. in May, 195,000,000 in April, and 215,000,000 in March.

The export demand has been slightly better this week than last, and London prices have held up well.

Lead

Almost daily reductions in price have been made by the American Smelting & Refining Co. during the last week. On Thursday, July 5, the official price of lead at New York was reduced from 6.50c. to 6.35c.; on July 6 to 6.25c.; on July 9 to 6.10c.; and on July 10 to 6.00c.

The principal topic of interest in the lead market has been the decline in prices quoted by the Smelting company. It is generally believed that the July requirements of their contract customers proved to be disappointingly small and that the company accordingly thought the price likely to drop to the 6c. level within the next month or two owing to the decreased amount of metal going into consumption. In the meantime, the market being quiet, it would be advisable to reduce the price quickly in order to prevent buying a lot of lead in ore, at high prices, that could only be sold later, after smelting, at a considerable loss. Then, too, the low prices would tend to discourage overproduction. The foregoing is the explanation generally heard; the Smelting company representatives are non-committal except that they affirm the higher levels were not justified in view of current production and anticipated consumption. Certain it is, that the daily decline has not had any marked effect in stimulating buying, and is not likely to have until a stable level is reached. As there was no decline today, possibly this will be the present price of 6c. The threat of imported lead has long since ceased to be a factor, for the price in London has held up very well, all things considered; that market has shown a surprisingly good ability to absorb the Mexican production.

Sales for the week have improved somewhat, but have not reached a large total. At 6c. there is no pressure to sell and dealers seem to be having some difficulty in obtaining important tonnages at that price. Most of the business has been done on the New York basis, and the Middle Western market has been only a nominal one, with sellers at St. Louis and Chicago inclined to quote not more than 20 points under the eastern price. One parcel of desilverized lead was sold in Chicago today for 5.75c.

Zinc

The price of zinc has hardened perceptibly since a week ago. At first, the increased price was largely occasioned by a reluctance by producers to sell at levels which gave them no profit considering the price of ore. Then, in the last day or two, consumers have become somewhat alarmed at the increasing prices, and more active buying has shoved prices up further. Dealers, galvanizers, and brass manufacturers have all entered the market. Spot metal is still in ample supply, and today could be obtained for about 6.10c., with premiums of about 5 points per month asked for forward deliveries. The curtailed production of ore has also helped to harden the market. Zinc is now selling at higher prices than lead for the first time in seven months. High-grade continues unchanged at 8@8.50c. delivered in the East.

Tin

Nothing particularly exciting has happened in the tin market during the week and prices have changed only slightly. No further important collapse is expected, though it is decidedly uncertain which way the market will move next. Consumers continue to buy cautiously. Practically all the 99 per cent tin now available is the Chinese article, which is offered in small amounts. Forward deliveries of Straits have been obtainable at one-eighth to one-quarter cent discount from spot.

Arrivals of tin, in long tons: July 2d, China, 130; London, 125; 3d, Liverpool, 235; London, 75; Straits, 35; 5th, Java, 50; London, 50; 6th, London, 50; Straits, 150; China, 125; 9th, Liverpool, 125; 10th, Liverpool, 100; Straits, 25; China, 75; total to July 10, 1,350.

Silver

Silver improved somewhat during the last week, only to lose again the advance on the 11th, due to China sales in London. The New York market closes quiet, with a steadier tone on account of the reluctance of producers to sell.

Mexican Dollars—July 5th, 48; 6th, 48⅜; 7th, 48¼; 9th, 48½; 10th, 48⅜; 11th, 47⅞.

Foreign Exchange

Sterling is somewhat higher than a week ago, but a slight net loss has been registered by most of the Continental exchanges. On Tuesday, July 10, cable quotations on francs were 5.89c.; lire, 4.295c.; marks, 0.0003¾c.; and Canadian dollars, 2⅞ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 26@27c. per lb.; 98 per cent, 25@26c. London, £115, 98 per cent.

Antimony — Chinese and Japanese brands, 6.75@6.875c. Market slightly weaker owing to unsold accumulations. W.C.C. brand, 7.75c. Cookson's "C" grade, 10@10.50c.

Bismuth—$2.55 per lb. London, 10s.

Cadmium—$1 per lb. London, 5s.

Cobalt—$3 per lb. for spot.

Iridium—$275@$300 per oz.

Nickel—27@32c. per lb. for 99 per cent virgin metal. London, £130@£135 per long ton.

Palladium—$80@$81 per oz.

Platinum—$116 per oz. London, sponge, £23; manufactured, £25.

Quicksilver—$67 per 75-lb. flask. Quiet. San Francisco wires $66.15. London, £10 10s.

The prices of **Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Selenium, Tellurium, Thallium,** and **Tungsten** are unchanged from prices given July 7.

Metallic Ores

Chrome, Iron Ore, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and **Zircon Ore** are unchanged from the quotations published July 7.

Zinc and Lead Ore Markets

Joplin, Mo., July 7—Zinc blende, per ton, high, $36.60; basis 60 per cent zinc, premium, $36. Prime Western, $33@$35; fines and slimes, $33@$31; average settling price, all grades of blende, $34.39.

Lead, high, $89.20; basis, 80 per cent lead, $85@$65; average settling price, all lead ore, $87.49 per ton.

Shipments for the week: Blende, 8,345; lead, 1,341 tons. Value, all ores the week, $404,290.

The estimated production of the week was 1,220 tons, a decrease in output of 9,330 tons from the previous week. Cessation of operations is practically 90 per cent. Producers claim it will be 80 to 85 per cent restriction of output next week, with a 50 per cent curtailment throughout July.

While only 8,345 tons of blende was shipped, it is evident 7,000 tons was from reserve stock, a portion of ore previously purchased. It is reported that one smelting company was buying ore from a subsidiary mining company this week on $33 basis, but no other purchases of Prime Western ore were reported under $35 basis.

Platteville, Wis., July 7—Blende, basis 60 per cent zinc, $38 per ton. Lead, basis 80 per cent lead, $70 per ton. Shipments for the week: Blende, 362 tons; lead, 40 tons. Shipments for the year: Blende, 18,067; lead, 420 tons. Shipments for the week to separating plants, 890 tons blende.

Non-Metallic Minerals

Fluorspar—Washed gravel, plus 85 per cent CaF_2, minus 5 per cent SiO_2, $23.50 per ton, Illinois; acid lump, $42 per ton. Market quiet. For other quotations, see July 7 issue.

Talc—In New York, double air-floated, $14.75 per ton. Market good.

In California, 200 mesh, "Sierra Snow," $18 per ton, bags extra. "Sierra Cloud," air floated, $25 per ton. Market fair.

Other talc quotations in July 7 issue.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Manjak, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Tripoli** are unchanged from the July 7 prices.

Mineral Products

Arsenious Oxide (white arsenic)—Owing to the termination of the season there is practically no demand now for spot supplies. Domestic producers offer deliveries over the remainder of the year at 10@11c. per lb. The market is quiet. Imported arsenic can be obtained at from 9@9.50c. There seems to be nothing to indicate that the arsenic demand will not be equally as good next season as during that just passed.

Copper Sulphate, Potassium Sulphate, Sodium Nitrate, and **Sodium Sulphate** are unchanged from quotations of July 7.

Ferro-Alloys

Ferromanganese—Importers have reduced prices to $117.50 per long ton, c.i.f. duty paid. Spiegeleisen unchanged from the July 7 prices.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices published July 7.

Metal Products

Rolled Copper—Sheets, 23.75c., base; wire reduced to 17.25c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets** are unchanged from the prices given in the July 7 issue.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick and **Zirkite** are unchanged from the July 7 prices.

The Iron Trade

Pittsburgh, July 10, 1923

Finished-steel prices are steady. Coke and scrap prices have been declining since late in March and pig iron for nearly as long, but this represents the usual procedure in the market. The mills are disposed to maintain prices as long as they have business on books.

Pig Iron.—Bessemer iron remains nominal at $27.50, Valley. Basic has sold at $25, Valley, or $1 decline from the nominal market formerly quoted. Foundry is nominal at $26.50, Valley. There is a remarkable absence of inquiry.

Connellsville Coke.—Furnaces that did not contract for third quarter have no trouble in buying coke, and the spot market is easier, at $4.75@$5, with spot foundry remaining at $5.50@$6.

Freight Rates on Metals, Ores, and Concentrates

In Carload Lots

Freight Rates on Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$13.40	.....
Garfield, Utah	Perth Amboy, N. J.	16.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy, N. J.	16.50	$14.50
Miami, Ariz.	Perth Amboy, N. J.	16.50	14.50
Anaconda, Mont.	Perth Amboy, N. J.	16.50	.....
Butte, Mont.	Perth Amboy, N. J.	16.50	.....
Humboldt, Ariz.	Chrome, N. J.	16.50	14.50
Douglas, Ariz.	Perth Amboy, N. J.	16.50	14.50
Globe, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clifton, Ariz.	Perth Amboy, N. J.	16.50	14.50
Clarkdale, Ariz.	Chrome, N. J.	16.50	14.50
Copperhill, Tenn.	Laurel Hill, N. Y.	10.80	.....
Tooele, Utah	Chrome, N. J.	16.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a)9.60	.....
Hancock, Mich.	New York	(a)9.60	.....
Hubbell, Mich.	New York	(a)9.60	.....
Dollar Bay, Mich.	New York	(a)9.60	.....
Tacoma, Wash.	New York (water)	Around $4.00	
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	16.50	14.50

(a) Applies April 1 to Nov. 30 of each year.

Lead Bullion; Also Pig Lead Where Shown

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	14.15	$9.65
Leadville, Colo.	16.50	11.40
East Helena, Mont.	16.50	11.40
El Paso, Tex. (domestic)	12.00 Via Gulf	
	(c)14.00 All Rail	(b)7.76½
Omaha, Neb.	9.60	3.65
Murray, Utah	16.50	11.40
Midvale, Utah	16.50	11.40
Tooele, Utah	16.50	11.40
East Chicago, Ill.	6.40	(a)2.00
Kellogg, Idaho	16.50	11.40
Carnegie, Pa.	3.80	(a)5.00
Selby, Calif.	Conference Rate $6.00 via Canal	.....
Herculaneum, Mo.	(a)8.80	(a)1.80
Federal, Ill.	7.00	(a)1.80
Collinsville, Ill.	7.00	(a) .75½
Granby, Mo.	(a)10.50	(a)3.50
Joplin, Mo.	(a)10.50	(a)3.50

(a) Pig lead only.
(b) Pig lead only when originating in Mexico.
(c) Shipments of bullion originating in Mexico, $2 per ton less.

Zinc

From	Rates per Net Ton To East St. Louis	To New York
Donora, Pa.	(a)$4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	*7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	6.40
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	14.50
Park City, Utah	11.40	16.50
Canyon City, Colo.	15.55	22.55

(a) To St. Louis, Mo.

Zinc Ores and Concentrates to Oklahoma Smelters

Commodity	To	From	Rate per Net Ton
Zinc ore and concentrates, carloads	Bartlesville, Okla.	Altoona, Kan.	$2.10
		Pittsburg, Kan.	*1.10
		Galena, Kan.	1.30
		Joplin, Mo.	1.40
		Iola, Kan.	1.80
		Baxter, Kan.	1.40
		Miami, Okla.	1.40
		Quapaw, Okla.	1.40
		Kansas City, Mo.	1.60
Zinc ore and concentrates, carloads	Sand Springs, Okla.	Miami, Okla.	2.20
		Quapaw, Okla.	2.20
		Galena, Kan.	1.50
		Joplin, Mo.	1.50
		Iola, Kan.	2.40
		Cave Springs, Mo.	2.00
		Cent City Spur, Mo.	2.00
Zinc ore and concentrates, carloads	Dewar, Okla.	Chitwood, Mo.	2.00
	Kusa, Okla.	Galena, Kan.	1.50
	Henryetta, Okla.	Iola, Kan.	2.40
		La Harpe, Kan.	2.40
		Mound City, Kan.	.50
Zinc ore and concentrates, carloads	La Harpe, Kan.	Oswego, Kan.	.50
		Parsons, Kan.	.50
Zinc ore and concentrates, carloads	Coffeyville, Kan.	Galena, Kan.	1.10
		Joplin, Mo.	*1.22
Lead ore and concentrates, carloads	Bartlesville, Okla.	Baxter, Kan.	1.80
		Miami, Okla.	1.80
		Quapaw, Okla.	1.80

Rates on Ores and Concentrates

From	To	Value of Product $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	.17	17	.17	.17	.17
Butte, Mont.	Black Eagle, Mont. (a)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	.....	.....	.....	.....	.....	.....	.....
Great Falls, Mont.	East Helena, Mont.	.....	.....	1.50	.....	.....	.....	1.91	.....	2.36	.....	.....	.....	.....	.....	2.48
Butte, Mont.	East Helena, Mont.	.....	.....	1.17	.....	1.46	.....	1.69	.....	2.03	.....	.....	.....	.....	.....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	.....	.....	.....	.....	.....	.....	.....	.....	6.30	7.00	7.70	.....	8.35	8.60	8.85
Johannesburg, Calif.	Selby, Calif.	.....	.....	.....	3.40	.....	4.10	.....	4.80	5.50	6.20	6.90	.....	7.60	8.00	8.30
Johannesburg, Calif.	Humboldt, Ariz.	.....	.....	.....	3.40	.....	4.10	.....	4.80	5.50	6.20	6.90	.....	7.60	8.00	8.30
Fioche, Nev.	Humboldt, Ariz.	.....	4.50(c)	7.74	.....	8.55	.....	9.36	.....	9.99	.....	.....	11.25	.....	.....	12.42
Creede, Colo.	Durango, Colo.	.....	.....	3.25	3.50	3.75	4.00	.....	4.25	4.75	5.25	5.75	6.05	.....	.....	7.10
Ouray, Colo.	Durango, Colo.	.....	.....	4.30	4.80	.....	5.05	.....	.....	5.90	.....	6.30	.....	.....	.....	7.70
Kokomo, Colo.	Durango, Colo.	.....	6.00	.....	.....	6.50	7.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
Telluride, Colo.	Durango, Colo.	.....	.....	.....	.....	.....	4.30	.....	5.00	5.90	6.30	6.30	.....	.....	.....	7.70
Silverton, Colo.	Durango, Colo.	.....	.....	1.40	1.40	.....	.....	2.20	.....	.....	2.30	2.55	.....	2.80	.....	2.80
Tyrone, N. M.	Douglas, Ariz.	.....	.....	1.60	1.90	.....	2.20	.....	2.50	2.80	.....	.....	3.40	.....	.....	3.80
Tyrone, N. M.	El Paso, Tex.	.....	.....	1.60	1.90	.....	2.20	.....	2.50	2.80	.....	.....	3.40	.....	.....	3.80
Lordsburg, N. M.	Douglas, Ariz.	.....	1.00	1.30	1.60	.....	1.90	.....	2.20	2.50	.....	.....	2.80	.....	.....	3.40
Lordsburg, N. M.	El Paso, Tex.	.....	1.00	1.30	1.60	.....	1.90	.....	2.20	2.50	.....	.....	2.80	.....	.....	3.40
Tombstone, Ariz.	Douglas, Ariz.	.....	.....	.60	.....	.90	.....	.....	.....	1.30	.....	.....	1.60	.....	.....	1.90
Tombstone, Ariz.	El Paso, Tex.	.....	.....	1.90	.....	2.50	.....	.....	.....	3.80	.....	.....	4.40	.....	.....	4.40
Silver City, N. M.	Douglas, Ariz.	.....	.....	2.48	.....	3.15	.....	.....	.....	3.83	.....	.....	.....	.....	.....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	.....	.10	.....	.40	.....	.50	.....	.80	.90	.....	.....	1.00	.....	.....	1.10

(a) Minimum tonnage of 500 tons per day. (b) In open cars, minimum 80,000 lb. (c) Siliceous ore tailing

Rates on Ores and Concentrates

From	To	Value of Ores and Concentrates $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho	Bradley, Idaho	.....	.....	.....	.....	.....	.....	.....	.....	.68	.....	.....	.....	.....	1.02
Burke and Wallace, Idaho	East Helena, Mont.	.....	.....	.....	.....	3.00	.....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	.....	.....	.....	3.38	.....	3.83	.....	4.16	.....	.....	.....	.....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	.....	.....	.....	.....	.....	.....	.....	.....	.35	.....	.....	.....	.....	.50
Bayview, Idaho	Bradley, Idaho	.....	.....	.....	.....	.....	.....	.....	3.75	.....	.....	4.37½	.....	.....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	.....	1.50	.....	1.75	.....	2.00	.....	.....	2.25	.....	2.50
Eureka, Utah	Salt Lake Smelters	1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	.....	1.25	.....	1.50	.....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	.....	.40	.....	.75	.....	.....	.....	.95	.....	.....	1.10	.....	.....	1.25
Cherry Creek, Nev.	Garfield, Utah (b)	.....	.....	4.60	.....	5.10	.....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	.....	.....
Goldfield, Nev.	Salt Lake Smelters	.....	.....	5.10	.....	5.80	.....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters	.....	.....	3.20	.....	3.80	.....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	.....	.....	3.20	.....	3.80	.....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters	.....	.....	3.60	.....	4.30	.....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	.....	.....	3.20	.....	3.90	.....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	.....	.....	5.10	.....	5.80	.....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	.....	3.50	.....	4.00	.....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.50

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. (c) Minimum weight, 40,000 lb.
*Indicates a change of tariff since last report.

COMPANY REPORTS

Silver King Coalition Mines Co.

Silver, Lead; Park City, Utah

A statement of the earnings and expenditures of the Silver King Coalition Mines Co. for 1922 is as follows:

Earnings

Ore sales	$1,415,278.49
Royalties, interest, rentals	26,352.00
Net sales and miscellaneous earnings	6,980.38
	$1,448,610.87

Expenditures

Development expense	$79,218.68	
Ore extraction	259,626.32	
Drainage	6,681.02	
Hoisting and hauling	102,383.83	
Milling	58,937.39	
Marketing	30,394.69	
Other expenses: surface, general mine, indirect, ground rental, taxes, insurance, workmen's compensation, administrative and legal	116,197.88	
	$653,439.81	
Depreciation, 1922	48,977.62	702,417.43
Net earnings for the year		$746,193.44
Less reserve for net proceeds tax		58,880.67
		$687,312.77
Dividends paid		364,830.00
Surplus through 1922 operations		322,482.77
Adjustments		26,775.49
Total surplus increase		$349,258.26

During the year production of ore was as follows:

	Tons Produced	Tons Shipped
Crude first-class	18,966	18,966
Crude iron ore	5,543	5,543
Crude second-class	49,593	.....
From which was produced and shipped:		
Lead concentrates	.....	7,447
Iron concentrates	.....	5,123
Lease ore	515	.....
	74,617	37,594

Average contents of product per ton:

	Lead, Per Cent	Silver, Oz.	Gold, Oz.	Copper, Per Cent
Crude first-class ore	28.56	41.41	0.061	0.85
Crude iron ore	5.13	7.49	0.053	0.27
Lead concentrates	26.13	21.54	0.048	0.26
Iron concentrates	7.96	11.55	0.033	0.04
Lease ore	37.30	43.35	0.112	0.53
Total contents:	Lead, Lb.	Silver, Oz.	Gold, Oz.	Copper, Lb.
Crude first-class ore	10,840,570	785,391	1,160	320,671
Crude iron ore	568,752	41,510	296	29,885
Lead concentrates	3,892,586	160,385	358	39,489
Iron concentrates	815,672	59,154	168	27,962
Lease ore	383,942	22,311	57	5,451
	16,501,522	1,068,753	2,042	423,458

Sold for:

Crude first-class ore	$1,042,797
Crude iron ore	42,364
Lead concentrates	255,311
Iron concentrates	74,806
Lease ore—sold for $33,150.40—royalty	10,123
Net to company	$1,425,401

Prospecting and development work will undoubtedly disclose new and valuable orebodies, according to the manager. The new mill started operations March 1, 1922, and after the necessary minor adjustments were made its efficiency exceeded expectations. Development work is well in advance of ore extraction, and metallic contents and value per ton of ore mined and milled is increasing.

The balance sheet is as follows:

Assets

Property		$5,480,264.48
Mine plant and equipment		449,275.95
Coal yard and store		4,637.85
Inventories and Salt Lake office		85,950.63
Cash		311,956.01
Stocks and securities:		
Liberty bonds, at cost	$297,338.10	
Treasury stock	141,350.00	
Fairview Mining Co. stock	11,402.66	
		450,090.76
Ore in transit		90,597.82
Accounts receivable and deferred charges		19,395.21
		$6,892,168.71

Liabilities

Accounts payable	$31,529.39
Reserves	102,362.33
Capital stock authorized and issued	6,250,000.00
Surplus	508,276.99
	$6,892,168.71

Officers: David Keith, president; T. F. Kearns, vice-president; W. Mont Ferry, vice-president and managing director; F. J. Westcott, secretary and treasurer; M. J. Dailey, mine manager; and M. G. Heitzman, superintendent. Directors: all the above except Heitzman, and M. C. Fox, H. Newell, W. G. Halloran, and J. Ivers, Jr. Main office, 1,008 Kearns Building, Salt Lake City, Utah.

The Lucky Tiger-Combination Gold Mining Co.

Gold, Silver; El Tigre, Sonora

The following is a brief summary of the results obtained at the mine and mill of the Lucky Tiger-Combination Gold Mining Co. at El Tigre, district of Moctezuma, Sonora, Mexico, during 1922, according to the annual report:

Production from the mine, 71,718 dry tons of a gross value of	$2,372,340.28
Concentrator produced 6,357.5 tons concentrate, gross value	2,238,073.28

This represents a combined extraction of 94.3 per cent of the values of gold, silver, copper and lead.

Total operating expenses, not including depletion nor United States administration charges	$1,469,170.37
Sundry profits	32,465.24
Total profits	935,635.15
Total profits before deducting taxes and provision for reserves	957,203.54

Prospects for another successful year appear promising. There is no shortage of labor and relations with the local and state governments are satisfactory.

The capital stock authorized amounts to 800,000 shares, of $10 par each, of which 715,337 are outstanding. In 1922, dividends 141 to 152 were paid, amounting to $736,797.11. The total dividends paid to date, beginning with 1908, have been $8,964,627.22.

Officers: H. Vanderslice, president; W. A. Moses, vice-president; A. E. Mosier, vice-president; H. B. Duke, vice-president; L. R. Budrow, vice-president and general manager; O. E. McMullen, secretary and auditor; John M. Kelley, treasurer; R. T. Mishler, manager; E. J. Stanley, mine superintendent; W. A. Wasley, mill superintendent. Head offices: Kansas City, Mo., and Douglas, Ariz.

MINING STOCKS

Week Ended July 7, 1923

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	56	54	56	June 23, Q	$1.50
Alaska-Br. Col.	N. Y. Curb	1⅛	1⅛	1⅛		
Allouez	Boston	17	17	17	Mar. '19	1.00
Anaconda	New York	40½	38	39	Je. 16, Jy. 23	0.75
Arcadian Consol.	Boston	*95	*70	*95		
Ariz. Com'l.	Boston	10½	8½	10½	Oct. '18, Q	0.50
Calaveras	N. Y. Curb	2⅛	2	2		
Calumet & Arizona	Boston	47	46	47	June '23,	1.00
Cal. & Hecla (New)	Boston	42½	40½	42	June '23, Q	10.00
Centennial	Boston	8½	8	8½	Dec. '18, SA	1.00
Cerro de Pasco	New York	39½	38	39	May '23,	1.00
Chile Copper	New York	25⅞	24⅝	25½	Je. 2, Je.30 Q	0.62½
Chino	New York	19½	17⅞	18½	Sept. '20, Q	0.37½
Con. Coppermines	N. Y. Curb	2⅜	2¼	2⅜		
Copper Range	Boston	29½	27	29½	May '23, Q	1.00
Crystal Copper	Boston Curb	*95	*75	*82		
Davis-Daly	Boston	2⅜	2¼	2⅜	Mar. '20, Q	0.25
East Butte	Boston	5⅜	5	5⅜	Dec. '19, A	0.50
First National	Boston Curb	35	26	35	Feb. '19, SA	0.15
Franklin	Boston	1¼	1	1		
Gadsden Copper	Boston Curb	*68	*50	*68		
Granby Consol.	New York	17½	16	16½	May '19, Q	1.25
Greene-Cananea	New York	21	16⅛	21	Nov. '20, Q	0.50
Hancock	Boston	1⅜	1⅛	1⅜		
Howe Sound	N. Y. Curb	3⅛	3	3⅛	Jy. 2, Jy.16	0.05
Inspiration Consol.	New York	28⅜	28	28⅜	Je.14, Jy. 2 Q	0.50
Iron Cap	Boston Curb	4⅜	4⅛	4⅜	May 23, K	0.15
Isle Royale	Boston	20½	19	20½	June '23, Q	0.50
Kennecott	New York	34¼	32	34⅛	Je. 8, Jy. 2 Q	0.75
Keweenaw	Boston	1	*80	*80		
Lake Copper	Boston	2	1¾	2		
Magma Copper	New York	29⅛	28⅜	29⅛	Jan. '19, Q	0.50
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Mass Consolidated	Boston	1⅜	1⅛	1⅛	Nov. '17, Q	1.00
Miami Copper	New York	22⅜	22⅛	22⅜	Au. 1, Au. 15, Q	0.50
Michigan	Boston	1¼	*90	1		
Mohawk	Boston	49	39	41	June '23, Q	1.00
Mother Lode Coa.	New York			8⅜	Je. 8, Je. 30, Q	0.50
Nevada Consol.	New York	12¼	11⅛	11⅜	Sept. '20, Q	0.25
New Cornelia	Boston	17	16½	17	May '23, Q	0.25
North Butte	Boston	3½	2¼	2¼	Oct. '18, Q	0.25
Ohio Copper	N. Y. Curb	*65	*51⅜	*61		
Old Dominion	Boston	18⅜	18	18	Dec. '18, Q	1.00
Osceola	Boston	28	26	26½	June '23, Q	1.00
Phelps Dodge	Open Mar.	†160	†170	....	Je. 20, Jy. 2 Q	1.00
Quincy	Boston	26	23	26	Mar. '20, Q	1.00
Ray Consolidated	New York	10⅜	10	10⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅛	1	1⅛		
St. Mary's Min. Ld.	Boston	33	31	33	Mar. '23, K	3.00
Seneca Copper	New York	7	6⅜	7		
Shannon	Boston	*55	*55	*55	Nov. '17, Q	0.25
Shattuck Arizona	New York	6	5⅛	6	Jan. '20, Q	0.25
South Lake	Boston			*12		
Superior & Boston	Boston	1	1	1		
Tenn. C. & C. cfs.	New York	8⅛	8⅛	8⅛	Je.30, Jy. 16, Q	0.25
Tuolumne	Boston	19	10	12	May '13,	0.10
United Verde Ex.	N. Y. Curb	30⅜	28⅜	29½	Jy. 5, Au. 7, Q	1.00
Utah Consol.	Boston	1⅜	1⅜	1⅜	Sept. '18,	0.25
Utah Copper	New York	58	56	58	Je. 8, Je. 30, Q	1.00
Utah Metal & T.	Boston	*75	*50	*70	Dec. '17,	0.30
Victoria	Boston	*75	*75	*75		
Winona	Boston	*60	*35	*40		
Wolverine	Boston	6	5	5⅛		
NICKEL-COPPER						
Internat. Nickel	New York	12⅛	11⅛	12⅛	Mar. '19,	0.50
Internat. Nickel pfd.	New York	80	77⅛	80	May '23, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh			3⅜		
National Lead	New York	111⅜	108	110½	Je.15, Je.30 Q	2.00
National Lead pfd.	New York			107	June '23, Q,	1.75
St. Joseph Lead	New York	17	17	17	Se.9,Se.20 Q,X	0.50
ZINC						
Am. Z. L. & S.	New York	9	8	8⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	36⅛	31	31	Nov. '20, Q	1.50
Butte C. & Z.	New York	6⅛	5⅛	6⅛	Mar. '23,	0.50
Butte & Superior	New York	20⅜	18⅛	20⅛	Je. 15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	6	5	5⅝	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	150½	148½	150	Jy.31,Au.10 Q	2.00
United Zinc	N. Y. Curb	*75	*75	*75		
Yellow Pine	Los Angeles	*65	*62½	*65	June '23, Q	0.03
SILVER						
Alvarado	N. Y. Curb	3½	3½	3½		
Batopilas Mining	New York	⅛	⅛	⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*34	*31	*31	May '20, K	0.03
Candelaria	N. Y. Curb	*8	*6	*8		
Castle-Trethewey	Toronto	*24½	*23½	*23½		
Coniagas	Toronto			2.70	May '21, Q	0.12½
Crown Reserve	Toronto	*59½	*57	*57	Jan. '17,	0.05
Hilltop-Nev.	N. Y. Curb.	1 3/16	1 3/16	1 3/16		
Kerr Lake	N. Y. Curb	2⅛	2⅛	2⅛	Jy. 2, Jy. 16, Q	0.12½
La Rose	Toronto	*32	*32	*32	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*18	*15½	*18	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	2.50	2.25	2.25	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	5¼	4	5	Jy. 1, Jy.20 Q	0.15
Ontario Silver	New York			4½	Jan. '19, Q	0.50
Temiskaming	Toronto	*40	*38½	*39½	Jan. '20, K	0.04

Stock	Exch.	High	Low	Last		Last Div.
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Boundary Red M.	N. Y. Curb	*13	*12	*12		
Carson Hill	Boston	6	5⅛	6		
Cresson Consol. G.	N. Y. Curb	3⅛	3 1/16	3 1/16	Apr. '23 Q	0.10
Dome Mines	New York	34⅛	31⅛	34⅛	Je.30, Jy.20 Q	1.00
Golden Cycle	Colo. Springs	1.02½	1.02	1.02½	Dec. '22, Q	0.02
Hollinger Consol.	Toronto	12.00	11.85	12.00	Je.28, Jy.16 M	0.05
Homestake Mining	New York	63	62	63	Je.20, Je.25 M	0.50
Kirkland Lake	Toronto	*83	*32½	*32½		
Lake Shore	Toronto	3.45	3.35	3.35	May '23, Q	0.02
McIntyre-Porcupine	New York	16⅞	16⅜	16⅜	May '23, Q	0.25
Portland	Colo. Springs			*35	Oct. '20, Q	0.01
Teck-Hughes	N. Y. Curb	1⅛	1 1/16	1 1/16		
Tom Reed	Los Angeles	*52½	*52½	*52½	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 1/16	1⅛	1⅛	Jy. '28, Q	0.15
Vipond Cons.	Toronto	*60	*56	*56		
Wright-Hargreaves	Toronto	3.20	3.10	3.10	Apr. '23,	0.02½
Yukon Gold	N. Y. Curb	1⅜	1⅜	1⅜	June '18,	0.02½
GOLD AND SILVER						
Boston-Mont. Corp.	N. Y. Curb	*13	½ c.	*13		
Con. Cortez	N. Y. Curb	*67	*65	*67		
Cons. Virginia	San Francisco	10½	9½	9½		
Continental Mines	N. Y. Curb			5¼		
Dolores Esperanza	N. Y. Curb	1⅛	1⅛	1⅛	Jy. 1, Jy.10 Q	0.05
Jib Consol.	N. Y. Curb	*70	*70	*70		
Tonopah Belmont	N. Y. Curb	*76	*75	*75	Apr. '23, Q	0.05
Tonopah Divide	N. Y. Curb	*52	*49	*50	May 23	0.10
Tonopah Extension	N. Y. Curb	2 1/16	1⅞	1⅞	Je. 9, Jy. 2	0.05
Tonopah Mining	N. Y. Curb	1 1/16	1⅛	1⅛	Apr. '23, Q	0.07½
Unity Gold	N. Y. Curb	3¼	3⅛	3¼		
West End Consol.	N. Y. Curb	*83	*80	*80	Mar. '23, Q	0.05
SILVER-LEAD						
Bingham Mines	Boston			*16½	Sept. 19, Q	0.25
Cardiff M. & M.	Salt Lake	*58	*45	*45	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	4	4	May '23, Q	0.10
Columbus Rexall	Salt Lake	*52	*45½	*47	Aug. '22,	0.03
Consol. M. & S.	Montreal	27½	25	25	Oct. '20, Q	0.62½
Erupcion	Boston Curb			2½	Apr. '23, Q	0.125
Federal M. & S.	New York	8	7	8	Jan. '09,	1.50
Federal M. & S. pfd.	New York	36	35⅛	36	June '23, Q	1.75
Florence Silver	Spokane			*38	Apr. '19, Q,X	0.01½
Hecla Mining	N. Y. Curb	7⅛	7⅛	7⅛	Je. 15 Q	0.50
Iron Blossom Con.	N. Y. Curb	*26	*24	*24	June '23	0.12½
Marsh Mines	N. Y. Curb			*11	June '21, I	0.02
Park City	Salt Lake	3.37½	3.37½	3.37½	Je.15, Jy.2 Q	0.12½
Park Utah	N. Y. Curb	3	2⅞	2⅞	Je.15, Jy.2 Q	0.15
Prince Consol.	Salt Lake	*2½	*2	*2½	Nov. '17,	0.02½
Silversmith	Spokane	....	....	*38	Jy. 2, Jy. 10	0.02
Simon Silver-Lead	N Y. Curb	....	....	*23		
Snowstorm Silver-L.	N. Y. Curb	....	....	*43		
Tamarack-Custer	Spokane			1.25	Je.30, K	0.02
Tintic Standard	Salt Lake	3.02½	2.97½	2.97½	July '23	0.15
Utah-Apex	Boston	3⅜	3¼	3½	June '23, Q,X	0.50
IRON						
Bethlehem Steel	New York	45⅜	41⅞	45⅜	Je. 1, Jy. 2 Q	1.25
Char. Iron	Detroit	*75	*50	*75		
Char. Iron pfd	Detroit	1⅜	1⅜	1⅜		
Colorado Fuel & Iron	New York	28	25⅛	28	May '23, Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb. '23, Q	2.00
Gt. North'n Iron Ore	New York			25½	Apr. '23	1.00
Inland Steel	N. Y. Curb			46½	June '23 Q	0.62½
Mesabi Iron	N. Y. Curb			9		
Replogle Steel	New York	15⅜	12½	15⅜		
Republic I. & S.	New York	44½	40⅜	44½	May '23	1.50
Republic I. S. pfd.	New York	88½	87	88	Je.15, Jy.2 Q	1.75
Sloss-Sheffield S. & I.	New York	42	39¾	39¾	Feb. '21	1.50
Sloss-Shef. S.&I. pfd.	New York			74	Je. 22, Jy. 2 Q	1.75
U. S. Steel	New York	92	89½	91⅞	Je.29, Q	1.25
U. S. Steel pfd.	New York	118⅞	117⅜	118	May '23	1.75
Virginia I. C. & C.	New York	52	52	52	Je.16, Jy. 2	2.00
Virginia I.C.&C.pfd.	New York			77½	Je.16, Jy. 2	2.50
VANADIUM						
Vanadium Corp.	New York	29½	24¾	29	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	62½	50½	50½	Je.30,Jy.15 Q	1.50
Asbestos Corp. pfd.	Montreal	79	76	76	Je.30,Jy.15 Q	1.75
SULPHUR						
Freeport Texas	New York	10⅛	9½	10½	Nov. '19, Q	1.00
Texas Gulf	New York	56½	53⅝	56½	June '23, Q	1.50
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3½	2⅞	2½		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	40¾	40¼	40¾	Je. 1, Q	0.75
Amer. Metal pfd.	New York			107½	Je. 1, Q	1.75
Amer. Sm. & Ref.	New York	56⅛	53⅜	55⅝	Jy. 9, Au. 1	1.25
Amer. Sm.& Ref. pfd	New York	94⅞	94½	94⅝	Au.10, Se.1 Q	1.75
U. S. Sm. R. & M.	New York	23	21⅛	23	Jan. '21, Q	0.50
U.S. Sm.R.& M. pfd.	New York	42	41	41	Jy.6,Jy.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Arthur E. Moysey; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Mines and Oil; Colorado Springs, Colorado Springs Stock Exchange.

Current Prices of Mine Materials and Supplies

Rise and Fall of The Market

Declines.—Steel structurals at $2.50 per 100 lb., Pittsburgh, against $2.50@$2.60, one month ago. Mill price of steel sheets and track bolts also lower. Concessions in steel prices due to lower costs of iron and lessening in demand for steel. Pine timbers dropped $2 per M. ft. in New York, during month; declines also occurred in Cincinnati, Minneapolis, Kansas City and Birmingham. Fir, hemlock and spruce are cheaper in Denver; fir is down in Minneapolis and spruce in Boston. Linseed oil dropped 6c. per gal. in New York and 9c. in Chicago, since June. Red and white lead declined ½c. per lb., f.o.b. New York. Decreases also occurred in dynamite, pine oil, zinc dust and litharge, during month.

Advances.—Cast-iron pipe firmer in New York and San Francisco; wrought steel pipe higher in St. Louis. Pine and hemlock timbers advanced in Boston; fir rose in Cincinnati. Portland cement, hose and belting prices firmer in New York.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$3.00	$4.45	$4.15	$5.10	$4.59
Black No. 28	3.85	5.20	5.00	6.15	5.15
Galvanized No. 28	5.00	6.35	6.10	6.50	6.15

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$40.00	.....	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$3.15	$2.25@2.35	$3.00	$4.00	$5.00	$3.75
Track bolts	4.00@4.25	3.25	4.00	5.00	6.20	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4.25	3.10

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.50	$2.75	$3.64	$4.30	$3.45	$3.40	$3.95
Channel, 3 to 15 in.	2.50	2.75	3.64	4.30	3.45	3.40	3.95
Angles, 3 to 6 in., ¼ in. thick	2.50	2.75	3.64	4.30	3.45	3.40	3.95
Tees, 3 in. and larger	2.50	2.75	3.64	4.30	3.50	3.40	3.95
Plates	2.50	2.75	3.64	4.40	3.45	3.40	3.95

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	20%
Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%

	New York	Cleveland	Chicago
Drill Rod (from list)	55%	40@55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
BUTT WELD	½ to 3	62	50½	¾ to 1½	30	13
LAP WELD	2½ to 6	59	47½	2½ to 4	26	11

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	44%	47%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$62.30	$50.80	$49.00	$60.20	$57.60	$62.00

Nuts—	New York	Cleveland	Chicago
Hot pressed, sq., per 100 lb. Off list	List net	$2.75	$2.50
Cold punched, sq., per 100 lb. Off list	List net	2.75	2.50

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1573	$0.1112	$0.0724	.....	$0.092	$0.108	.....
6x12x12	.2097	.1667	.0996	.....	.126	.156	.....
8x12x12	.2621	.2084	.1358	.....	.170	.244	$0.2691

MACHINE BOLTS—	New York	Cleveland	Chicago
½ and 1½x3 in. up to 12 in.	15 %	50%	50%

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$50.00	$51.00	$52.50	$54.50
3x10 to 10x10	54.00	55.00	55.50	57.50
3x12 to 12x12	58.00	59.00	58.50	60.50

Other Cities	8 x 8-In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir
Boston	$67.00	.....	$62.00	$57.00	$88.00	.....
Cincinnati	40.00	$75.00	75.00	90.00	44.00	$80.00
Denver	40.75	40.75	40.75	40.75	.....	41.75
Minneapolis	43.50	41.50	41.50	.....	46.00	43.75
Kansas City	44.25	46.50	46.50	.....	57.25	48.50
Birmingham	34@38	.....	.....	.....	43@50	.....

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$3.00	$3.45	$4.30	$4.25	$3.43	$4.95
Cut	....	5.50	5.80	5.75	3.74	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.80	$2.70@2.80	$2.40@2.50
Chicago, f.o.b.	2.20	2.20	2.05
Cleveland, f.o.b.	2.46	2.46	2.31

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel 280-lb. net Finishing	Lump, per Barrel 280-lb. net Common
New York	$18.20	$13.10	$3.75	$3.00@$3.25
San Francisco	22.00	16.00	....	(180-lb net) 1.75

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$1.10	$0.90	$1.28	$0.96

WHITE AND RED LEAD—Base price in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry or In Oil	White Yr. Ago Dry or In Oil
100-lb. keg	14.00	15.50	12.50	14.00	14.00	12.50
25 and 50-lb. kegs	14.25	15.75	12.75	14.25	14.25	12.75

HOSE—

Fire		50-Ft. Lengths
Underwriters' 2½-in. coupled		58c per ft.
Air		
	First Grade	Second Grade
¾-in., per ft.	3 ply $0.35½	4 ply $0.26½

Steam—Discounts from List

First grade..... 40% Second grade....40–5% Third grade.... 40–10%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition..... 60% Best grade..... 50–10%

LEATHER BELTING—List price, 2c. per sq. in. per ply.

Grade	Discount from list
Medium	30–10%
Heavy	20–5–2½%

RAWHIDE LACING—For cut, best grade, 40%, 2nd grade, 50%. For laces in sides, best, 48c. per sq.ft.; 2nd, 43c. Semi-tanned: cut, 40%; sides, 48c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Atlanta	$0.22	New Orleans	$0.18½
New York	.18½	Seattle	.18
Chicago	.18	San Francisco	.18

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1967	.2173
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.225	.25
New Orleans	.195	.220
San Francisco	.1625	.1925

FLOTATION OILS—All prices are per gal. in carload lots; 50-gal. bbls., gross weight 500 lbs.

Pine oil, steam dist., f.o.b. New York	$0.70
Pine oil, pure, dest. dist. f.o.b. New York	.65
Pine tar oil, ref. f.o.b. New York	.48
Pine tar oil, crude, tank cars f.o.b. Jacksonville, Fla	32½

CHEMICALS—

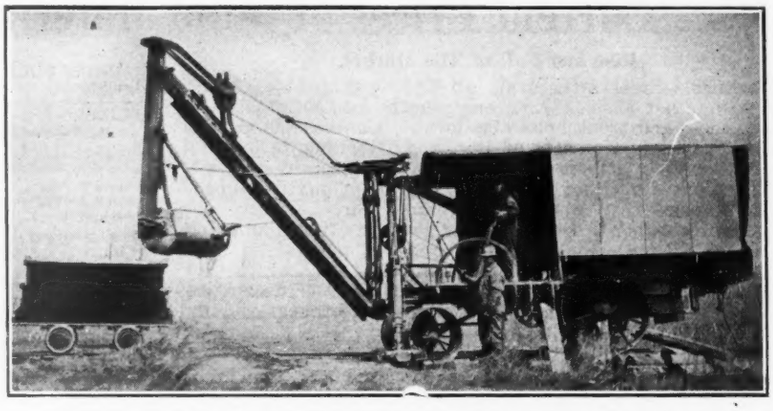
Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb	$0.09½
Litharge, delivered New York, casks, 500 lb. lots, per 100 lb	12.60
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb	.25

NEW MACHINERY AND INVENTIONS

Stripping Overburden With Excavator

In most of the quarries in the Middle West the rock stratification is horizontal and when the surface of the rock is uncovered it is smooth and level. For stripping operations in such a quarry an excavator machine equipped with a flat bottom skimmer bucket can be used to advantage. Other quarries, generally in the eastern part of the United States, present stripping problems more difficult to handle. Here the rock stratification lies on an angle and the surface of the rock formation when uncovered is so rough as to make it impossible to move a steam shovel or excavator about. The only possible device is a machine that will move on the natural ground level, which is comparatively smooth and regular, and which will reach down for the material in the manner of the positively controlled pull-stroke ditching bucket. In a Pennsylvania quarry an excavator machine so equipped is being used with success. It is manufactured by the Keystone Driller Co., of Beaver Falls, Pa.

The excavator is operated by an electric motor, and it is claimed that the current used costs about $3 for a ten-hour day. The depth of the cut made varies from 3 to about 15 ft. The ditcher bucket, it is claimed, can be operated in depressions and crevices where a clamshell bucket would not enter. As the bucket is positively controlled, the digging and dumping can both be done more accurately than would be possible with either a drag scraper or a clamshell bucket. Only two men are required to operate the machine. Its capacity is from 300 to 350 cu.yd. per day.

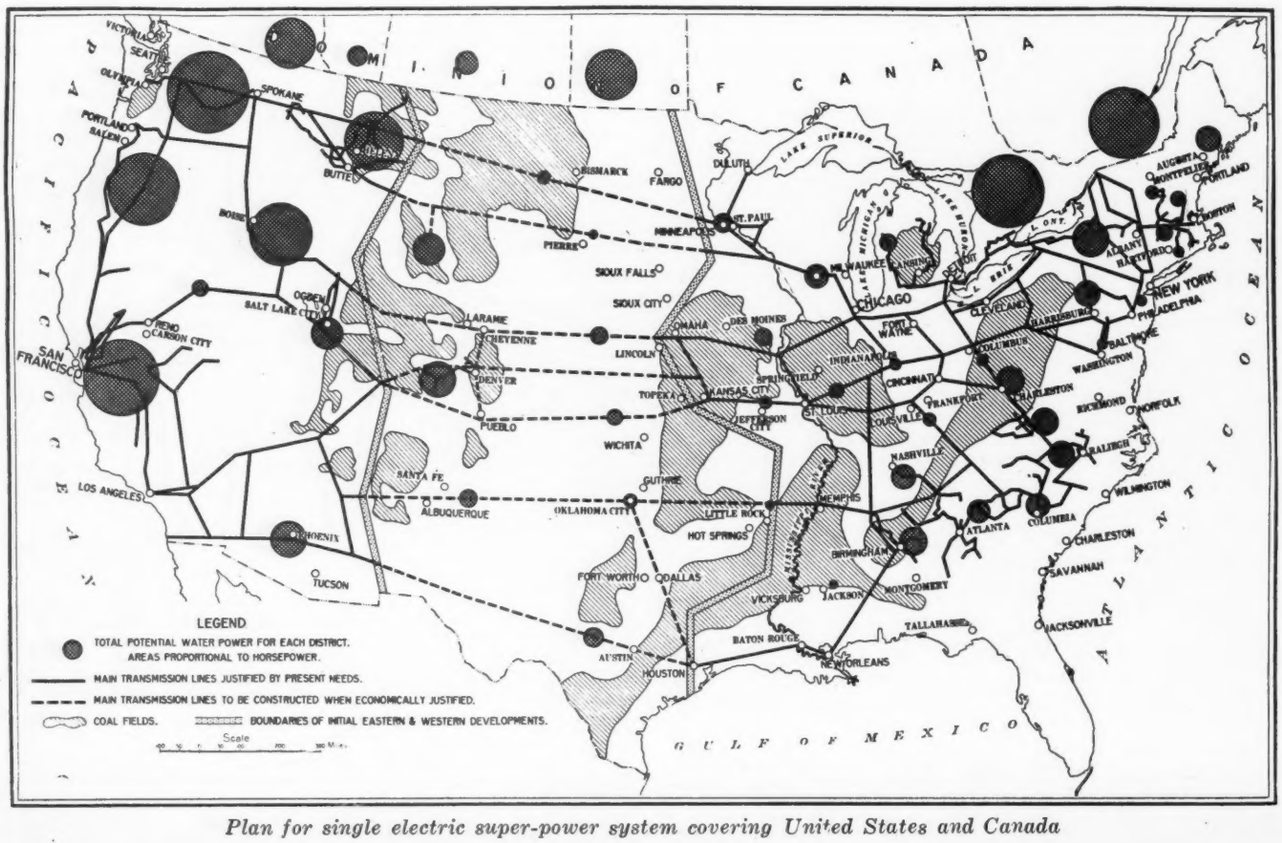


Excavator stripping overburden and dumping into 3-cu.yd. cars

INDUSTRIAL NOTES

A far-reaching conception of modern times is shown in the accompanying map, prepared by Frank G. Baum, hydro-electric engineer, which discloses a plan for a single electric super-power system to cover practically all of the United States and Canada. Though immense in its scope, it is nevertheless entirely practical with modern electrical apparatus, according to Guy E. Tripp, chairman of the Westinghouse Electric & Manufacturing Co., an advocate of this plan.

"The most important reason for the existence of a single electric system," says General Tripp, "is that it will make available to the entire nation our resources of water power and coal. This system will provide North America with the maximum amount of power at the lowest cost, distribute it to the largest number of people, and conserve our fuel resources in the most effective manner. The single system is not only practical and desirable, but in my opinion, it is very essential to American progress." It might be added that the creation of such a system will call for a large amount of copper.



Plan for single electric super-power system covering United States and Canada